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DIVISION OF WATER POLLUTION CONTROL
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A Volunteer Lake Monitoring Program was initiated by the Illinois EPA in 1981. Citizens were trained to measure water transparency using a Secchi disc. They also measured total depth and recorded field observations from a boat at three sites on their chosen lake. The monitoring season lasted from May through October; readings were to be taken twice a month during that time. The Secchi disc, data forms, and pospaid return envelopes were provided by the Agency.

This report details the methodology and results for the 1981 volunteer program and contains a primer to provide the non-technical person with a basic understanding of Illinois lakes, factors affecting their water quality, and actions that can be taken to protect and enhance them. Individual reports were also prepared for each lake.

Approximately 140 volunteers participated in monitoring 87 lakes in 1981. Average transparencies for the lakes ranged from 7.3 to 137.8 inches. Clearest lakes were generally located in northwestern and southern Illinois, while the most turbid lakes were found in central and south-central regions. Seventy-two percent of the lakes had average transparencies less than four feet, while approximately one-third had average transparencies less than two feet. Nine of the lakes were classified as mesotrophic and the remainder eutrophic.

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VOLUNTEER LAKE MONITORING, 1981

by

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June, 1982

FOREWORD

This report summarizes Illinois EPA's 1981 Volunteer Lake Monitoring Program and provides a primer on Illinois lakes. Companion reports are also available for each of the 87 lakes monitored by volunteers in 1981.

Sections I and II of this report present the Summary and Recommendations. Section III provides background material, program objectives, scope, and rationale; as well as the methodology for obtaining volunteers, training volunteers, performing the monitoring, and data handling and analysis. Data returns are also evaluated and the monitoring results presented and discussed.

Section IV, "Understanding Illinois Lakes," is designed to provide the nontechnical person with a basic understanding of lakes, factors affecting their water quality, and techniques for their protection and enhancement. References and a glossary are also included.

TABLE OF CONTENTS

SECTION PAGE

LIST OF TABLES vi

LIST OF FIGURES. vii

ACKNOWLEDGEMENTS ix

I. SUMMARY. 1

II. RECOMMENDATIONS. 4

III. 1981 VOLUNTEER LAKE MONITORING PROGRAM 6

    A. Introduction. 6

        1. Background 6
        2. Objectives 7
        3. Scope. 8
        4. Rationale. 8

    B. Methods 11

        1. Obtaining Volunteers 11
        2. Participants 11
        3. Training Volunteers. 19
        4. Monitoring Methods 22
        5. Data Handling and Analysis 22
        6. Special Monitoring 23
        7. Certificates of Appreciation 23

    C. Results and Discussion. 24

        1. Evaluation of Data Returns 24
        2. Monitoring Results 24

            a. Summary and Ranking of Data 27
            b. Categorization. 27
            c. Trophic State Index 34

IV. UNDERSTANDING ILLINOIS LAKES 37

    A. Introduction. 37

    B. Lake Origins. 37

        1. Natural Lakes. 37
        2. Artificially Constructed Lakes 38

SECTION PAGE

C. Lake Shape. 39

D. Lake Hydrology. 39

E. The Lake Ecosystem. 42

1. Lake Inhabitants 42
2. Inputs 46
3. Photosynthesis and Respiration 46
4. The Food Web 48
5. A Balanced Community 48

F. Thermal Stratification. 50

G. Lake Succession and Eutrophication. 52

H. Pollution 55

1. Watershed Sources of Pollution 57
2. Local Sources of Pollution 58

I. Water Quality Control Measures. 59

1. Individual Actions 59

2. Review of Water Quality Management Techniques. . . . 65

a. Lake Protection 65
b. In-lake Treatment or Control Techniques 68

V. REFERENCES 76

A. Literature Cited. 76

B. List of Recent Illinois EPA Lake Reports. 78

C. Popular-Nontechnical. 89

D. Limnology Textbooks 90

E. Limnological Methods. 91

F. Identification of Aquatic Plants. 91

G. Identification of Aquatic Animals 92

H. Lake Restoration. 92

I. Eutrophication. 93

SECTION PAGE

VI. GLOSSARY 94

VII. APPENDIX 107

A. Forms Used in the 1981 Volunteer Lake Monitoring Program. 107

B. Participants in the 1981 Volunteer Lake Monitoring Program. 120

C. Description of Monitoring Sites, 1981 Volunteer Lake Monitoring Program 125

D. Evaluation of Data Returns, 1981 Volunteer Lake Monitoring Program. 135

LIST OF TABLES

TABLE NO.	TITLE	PAGE
1	Background information for 87 lakes; Illinois EPA Volunteer Lake Monitoring Program, 1981.	13
2	Summary of data returns, Illinois EPA Volunteer Lake Monitoring Program, 1981.	25
3	Summary of Secchi disc transparency for 87 lakes, Illinois EPA Volunteer Lake Monitoring Program, 1981	28
4	Illinois EPA Volunteer Lake Monitoring Program participants, 1981	121
5	Description of monitoring sites, Illinois EPA Volunteer Lake Monitoring Program, 1981	126
6	Individual lake data returns, Illinois EPA Volunteer Lake Monitoring Program, 1981	136

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1	Ranking of 87 lakes by average Secchi transparency (inches), Illinois EPA Volunteer Lake Monitoring Program, 1981.	3
2	Location of 87 lakes included in the Illinois EPA Volunteer Lake Monitoring Program, 1981.	12
3	Illinois Environmental Protection Agency, Public Participation Regions, 1981	17
4	Illinois EPA Volunteer Lake Monitoring Program, 1981, distribution: a) of lakes by Public Participation region; b) of lakes by surface area categories; c) of lakes by ownership classification; d) of volunteers by Public Participation region	18
5	Illinois EPA, Volunteer Lake Monitoring Program, 1981; distribution of lakes by type of use: a) water supply; b) recreation.	20
6	Type and amount of recreational use for lakes in the Illinois EPA Volunteer Lake Monitoring Program, 1981: a) fishing; b) swimming; c) power boating; d) row boating; e) sail boating; f) camping; g) picnicking; h) waterfowl hunting; i) waterfowl observation; j) waterskiing	21
7	Evaluation of data returns for Illinois EPA Volunteer Lake Monitoring Program; a) by Public Participation region; b) by sampling period	26
8	Secchi disc transparency; Illinois Volunteer Lakes, 1981.	31
9	Distribution of mean Secchi disc transparency (inches), Illinois EPA Volunteer Lake Monitoring Program, 1981.	32
10	Mean Secchi disc transparency (inches) by region, Illinois EPA Volunteer Lake Monitoring Program, 1981	33

FIGURE NO.	TITLE	PAGE
11	Mean Trophic State Index (Secchi) by region, Illinois EPA Volunteer Lake Monitoring Program, 1981	33
12	Distribution of mean Trophic State Index (Secchi), Illinois EPA Volunteer Lake Monitoring Program, 1981.	35
13	Trophic State Index (Secchi), Illinois Volunteer Lakes, 1981.	36
14	A bathymetric map and the lake it represents (from Dion, 1978).	40
15	The hydrologic cycle (from Dion, 1978)	41
16	Microscopic plants and animals typical of Illinois lakes (from Dion, 1978)	44
17	Light zones and transparency measurements in lakes (from Dion, 1978)	47
18	A simplified food chain of a lake (from Dion, 1978).	49
19	The annual temperature cycle of a temperate region lake (from Dion, 1978).	51
20	The natural succession of a lake (from Dion, 1978).	53

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This report represents the coordinated effort of many individuals. Illinois EPA's Ambient Monitoring Unit, Planning Section, Division of Water Pollution Control, under the direction of Kenneth R. Rogers, was responsible for the design and implementation of the program, as well as preparation of this report. Substantial assistance was provided by the Agency's Public Participation Section supervised by Gloria Craven.

Program coordination was provided by Donna Sefton for the Illinois EPA's Ambient Monitoring Unit and Carol Beim for the Public Participation Section.

Volunteers were trained by Public Participation Coordinators Carol Beim, Bob Hagele, William Hammel, Patrick McCarthy, Vanessa Musgrave, and Dawn Wrobel.

Monitoring was performed by 141 volunteers throughout the state.

Data handling was performed by John Little, Jill Hardin, Marilyn Budd, Lori Whalen, Cora Stockton, and Karen Janssen. Data analyses were performed and tabular and graphical outputs obtained by John Little using programs developed for the Tektronix desk top computer terminal by Dr. David J. Schaeffer and Vladimir Chernomordikov. Graphics were prepared by John Little and John Lesnak.

The list of program participants in Appendix B and portions of the methods were contributed by Carol Beim. Figures 14-20 were reprinted from Dion (1978). Portions of Section IV (the primer), the references, and the glossary were modified from Dion (1978), Fulton, et al. (1971), Water Resources Center (1981), Kothandaraman (1981), and Sefton (1978).

The report was written by Donna Sefton and edited by Planning Section and Public Participation staff, particularly Jill Hardin, Kenneth Rogers, Gloria Craven, and Carol Beim. Marilyn Budd and Jeffrey Thean assisted in report preparation.

The report was typed by Word Processing under the direction of Norma Kraus and Diane Woodyard and printed under the direction of Claude Pearson and Ron Earley.

SECTION I. SUMMARY

1. This report summarizes the methods and results of the Illinois Environmental Protection Agency's 1981 Volunteer Lake Monitoring Program and provides a primer on Illinois lakes. The primer was designed to provide a nontechnical introduction to the physical, chemical, and biological characteristics of Illinois lakes, including lake origins, shape, hydrology, and ecology. Factors influencing lake quality, pollution sources, and methods for lake protection and enhancement are also reviewed. Actions which can be taken by individual lake residents to help protect and enhance the water quality of their lake are suggested on pages 59-64. A list of references for obtaining further information on lakes and a comprehensive glossary of common limnological terms are included.

2. A cooperative volunteer lake monitoring effort was initiated by the Illinois EPA in 1981 as part of an overall self-help service program being developed for lakes. In addition to expanding the Agency's lakes data base with information on present water quality and trends, the program was designed to involve citizens in learning about a lake so they could make more informed decisions regarding its use, protection, and enhancement.

3. Citizens selected a lake they were concerned about and were trained to measure water clarity or transparency by recording the depth to which a Secchi disc (an eight-inch diameter metal plate painted black and white in alternating quadrants) was visible. They also measured total depth and recorded field observations from a boat at three sites on their chosen lake. Readings were to be taken twice a month from May through October and reported to the Agency on special data forms. The Secchi disc, data forms, and postage paid envelopes were provided by the Agency. Volunteers were required to have available a boat with an anchor to perform the monitoring.

4. One hundred forty-one volunteers participated in monitoring 87 lakes in 1981. The lakes were located statewide. A little over half were publicly owned, while about one-third were owned by organizations. Thirty-three of the lakes were public water supplies, while all but one was used for recreation. Approximately three-fourths were impounding reservoirs and about half had surface areas of more than 100 acres.

5. Of the 87 lakes for which volunteer monitoring data was provided, 59.6% of all possible Secchi disc samplings were performed. Fifteen lakes had a 100% data return (i.e., were sampled during all 12 sampling periods). Thank you letters were sent to all volunteers. In addition, volunteers for lakes with data for six or more sampling periods received Certificates of Appreciation signed by the Agency Director.

6. Secchi monitoring data were computerized using STORET and the Tektronix desk top computer terminal to facilitate analysis and preparation of tables and graphs for reports. Each lake was also assigned a rank based on average Secchi transparency (Figure 1). The lake with the highest average transparency of 137.9 inches (Arbor in DuPage County, a borrow pit) ranked number 1, while the lake with the lowest average of 7.3 inches (Royal in Calhoun County, an Illinois River backwater) ranked number 87. The clearest lakes with the greatest average transparencies were generally located in northwestern and southern Illinois, while the most turbid lakes with the lowest transparencies were found primarily in central and south central regions.

7. Sixty-three (or 72.4%) of the 87 lakes monitored had average transparencies less than four feet, the minimum recommended for bathing beaches by the Illinois Department of Public Health (1976). Approximately one-third of the lakes had average values less than two feet, the level generally associated with use impairment problems for Illinois lakes. The grand mean (± standard deviation) calculated from all the lake averages was 39.1 (± 26.2) inches; this was almost identical to the grand mean of 39.5 (± 28.1) inches calculated for the 65 ambient lakes sampled in 1980-81.

8. Using the classification of lakes by Secchi disc transparency (Allum, et al., 1977) and associated Trophic State Index (Carlson, 1977), none of the lakes monitored would be considered oligotrophic, nine would be considered mesotrophic, and the remainder eutrophic.

9. In addition to this summary report, individual reports were prepared for each of the 87 lakes monitored by volunteers in 1981.

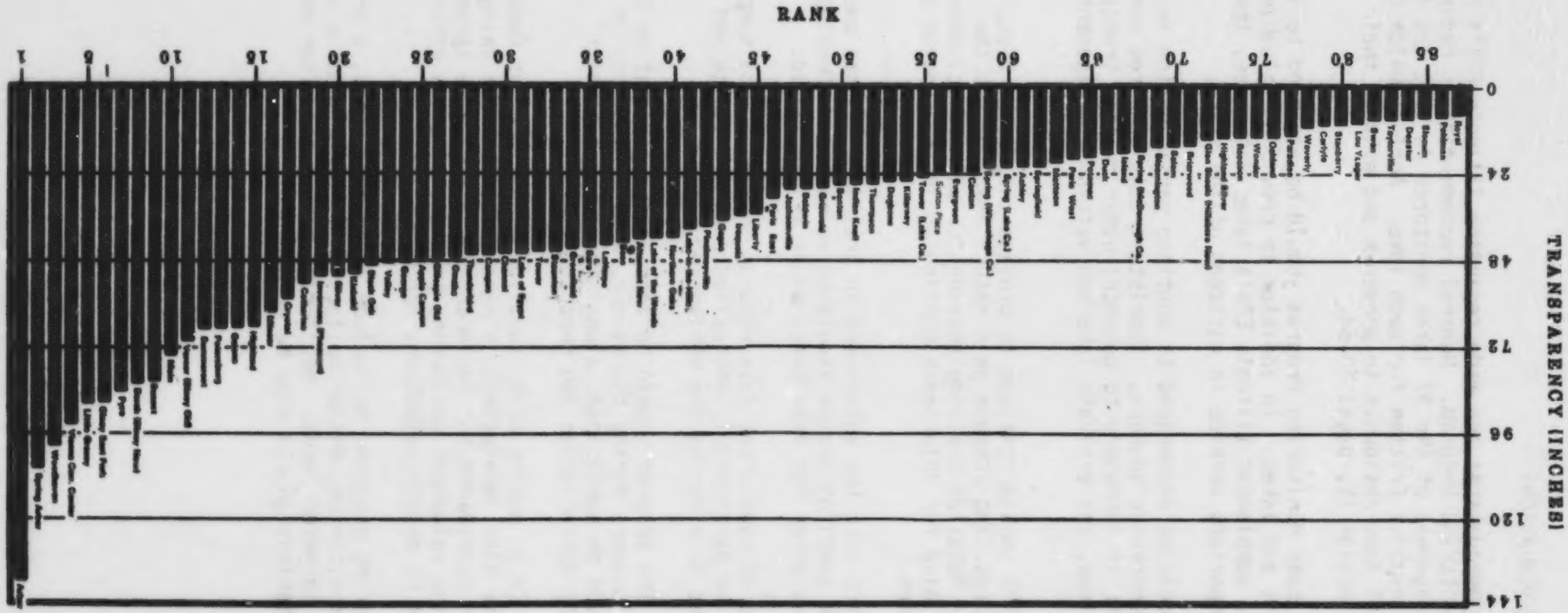

FIGURE 1. Ranking of 87 lakes by average Secchi transparency (inches), Illinois EPA Volunteer Lake Monitoring Program, 1981.

SECTION II. RECOMMENDATIONS

The following recommendations are made regarding Illinois EPA's future Volunteer Lake Monitoring Program. General recommendations regarding monitoring and management of the 87 lakes monitored in 1981 are included in the individual reports written for each lake. Actions which can be taken by individual lake residents to preserve and enhance their lakes are suggested in Section IV, pages 59-64.

1. The Volunteer Lake Monitoring Program should be expanded to include more volunteers and lakes. In addition to providing valuable information to supplement Illinois EPA's lakes data base, the program provides an important service to citizens of the state.

2. Volunteers should be encouraged to continue participation in the program for successive seasons. Consistent data gathered over a period of years is necessary to document water quality trends, identify problems, and evaluate lake and watershed management strategies.

3. The Illinois EPA should continue to provide the Secchi disc, fact sheet, data forms, and postage paid return envelopes to the volunteers. A detailed training session for all new volunteers and a refresher training for volunteers continuing in the program should also be provided.

4. Personal contact with the volunteers in training sessions and throughout the sampling season should be maintained. Development of a periodic newsletter for volunteers might be considered.

5. The importance of consistent data returns throughout the sampling season should be particularly emphasized during training and steps taken to ensure this during the monitoring.

6. Publicity for the program should be increased. In addition to soliciting volunteers during the winter, on-lake training in April-May should be publicized, along with distribution of Certificates of Appreciation and reports.

7. Certain lakes (e.g. public water supplies, Department of Conservation lakes and those with lake/watershed management programs being implemented or considered for implementation) should be targeted for inclusion in the volunteer monitoring program. Special efforts should be made to obtain volunteers for these lakes.

8. Special monitoring programs to include additional sites, a greater frequency of monitoring, and/or collection of water samples should be encouraged at targeted lakes. Monitoring before and after copper sulfate applications should also be encouraged.

9. Field observation forms and Secchi monitoring data forms should be revised and simplified as necessary. Photographs should be utilized in training sessions to demonstrate field observation of water color, sediment, algae, weeds, etc.

10. Volunteers should be asked to locate lakes on a county road map as well as provide a map of the lake. The lakes should also be located on topographic maps and these topographic maps used for the training sessions. Illinois EPA should continue to designate sites to be sampled for each lake and check to be certain volunteers are sampling these sites.

11. An improved data handling system should be developed for volunteer data. The check-in sheet should allow logging in of data returns for each volunteer. Data forms should be logged in, carefully reviewed, and the computer coded portion of the Secchi monitoring sheet completed as received. Training of volunteers to complete the computer coded portion of the Secchi monitoring sheet should be considered for the future.

12. Lake maps, lake assessment summaries and background summaries should be prepared early in the program to facilitate preparation of individual reports. Data from Secchi monitoring forms should be computerized (entered into STORET) and field observations summaries typed on a routine basis as they are received.

13. The mailing list of participants should be computerized and started as soon as the volunteer responses are obtained.

14. Individual lake reports should be routinely prepared only for those lakes which are monitored consistently during the sampling season.

15. In order to accomplish the above recommended program, greater commitment of data management staff will be necessary to handle data generated. Staff time for training and report preparation will also have to increase.

SECTION III. 1981 VOLUNTEER LAKE MONITORING PROGRAM

INTRODUCTION

There are approximately 2,900 lakes with surface areas of six acres or more in Illinois. Approximately 75 percent of these lakes are artificially constructed, 23 percent are river backwaters, and the remaining two percent are of glacial origin. About 850, or 30 percent of these lakes are publicly owned. In addition to being valuable recreational and ecological resources, these lakes serve as potable, industrial, and agricultural water supplies, as cooling water sources, for flood control, and for multipurpose uses.

Lakes also serve as traps for materials generated within their drainage basins. The trapped material generally lowers the water quality and may severely impact beneficial uses and significantly shorten the expected life span of the lake. Suspended and deposited sediment are the most serious use impairment problems for Illinois lakes. Excessive aquatic weed growth and/or algae blooms may result from the addition of nutrients such as nitrogen and phosphorus and limit recreational use and public water supply potential. Use may also be seriously impaired by heavy metal and pesticide contamination from industrial and agricultural sources. Lack of sufficient dissolved oxygen may limit the biological habitat and impair the public water supply use.

All citizens need to view their lake as a resource which will only continue to be available if certain steps are taken soon. One of the first steps is to assess the current condition of the resource. In recognition of this need, a cooperative volunteer lake monitoring effort was initiated by the Illinois EPA as part of an overall self-help service program being developed for citizens interested in lakes. The program was designed to involve citizens in learning about a lake so they could make more informed decisions regarding its use, protection, and enhancement. In addition, it would expand the Agency's lakes data base with information on present water quality and trends.

Background

Investigations of lakes are a relatively new undertaking of the Illinois EPA. The Agency first initiated a program to evaluate the characteristics of lakes in the state in 1977; physical characteristics, use and problems were surveyed for 353 lakes and 108 of these lakes were sampled that year. In August 1978, 23 southern Illinois lakes were sampled; while in 1979, 63 lakes were sampled: 15 monthly from May through October and the other 48 only twice, in early and late summer. An Ambient Lake Monitoring Program (ALMP) was initiated in 1980 to characterize existing water quality conditions. A minimum of 15 lakes are sampled by Agency personnel each year under the ALMP.

A list of reports resulting from these investigations of lakes by Illinois EPA is included in the references. In addition to increasing the understanding of Illinois lakes, these reports made several recommendations regarding Illinois' lakes program; among them was the establishment of a Volunteer Lake Monitoring Program (VLMP).

A cooperative lake monitoring effort between Illinois EPA and volunteers to determine water quality was first investigated on a pilot basis in 1979. Volunteers were supplied with written instructions on Secchi disc construction and use, as well as data reporting forms. Over 200 lake associations were contacted; 31 volunteers were originally obtained. However, only two lake clubs participated throughout the monitoring season. From this initital learning experience, Illinois EPA made several recommendations for program development (Hardin, 1980):

1. Contact a wider variety of organizations;
2. Advertise on the radio and in the newspaper;
3. Provide for more direct contact between volunteers and the Agency;
4. Conduct a more extensive sampling program; and
5. Provide volunteers with equipment needed.

The Fiscal Year 1981 Program Plan for the Division of Water Pollution Control included volunteer lake monitoring as a work element and committed Agency resources to the development of the program. The recommendations from the 1979 pilot efforts were incorporated in the development of the program and contributed to its success.

Objectives

Major objectives of the 1981 Volunteer Lake Monitoring Program were as follows:

1. To determine the present water quality of those Illinois lakes of concern to citizens;

2. To evaluate seasonal and long term water quality changes in the lakes;

3. To determine differences in quality within the lakes;

4. To compare the quality of each lake with that of other lakes in the state;

5. To relate lake quality to field conditions (e.g. water color, water level, waves, rainfall, cloud cover);

6. To relate lake quality to lake morphology (area, depth, shape) and watershed characteristics;

7. To evaluate possible causes/sources of lake water quality problems; and

8. To make citizens more aware of the above mentioned factors, as well as possible preventive/corrective actions.

Scope

Citizens selected a lake they were concerned about and were trained to measure water clarity or transparency by noting the depth to which a black and white Secchi disc was visible. They also measured total depth and recorded field observations at three sites on their chosen lake. Readings were to be taken twice a month from May through October and reported to the Agency on special data forms. The Secchi disc, data forms, and postage paid envelopes were provided by the Agency. Volunteers were required to have a boat with an anchor to perform the monitoring.

Approximately 140 volunteers participated in monitoring 87 lakes in 1981. The sampling data were computerized to facilitate analysis and preparation of tables and graphs for this report as well as for individual reports written for each of the 87 lakes monitored by volunteers in 1981.

Rationale

The Secchi disc was the basic tool used in the Volunteer Lake Monitoring Program. It is an eight-inch diameter weighted metal plate painted black and white in alternating quadrants which is used to determine the transparency or clarity of the water. The disc is lowered into the water with a calibrated rope and a measurement is taken on the rope when the disc is no longer visible. Its use is depicted in the cover photo and in Figure 17.

Measurements taken with a Secchi disc indicate the light penetration into a body of water. Microscopic plants and animals (algae and zooplankton), water color, and sediment (silt, clay, and organic matter) are factors which interfere with light penetration and lessen the Secchi disc transparency.

Secchi disc transparency may indicate the potential of the lake for exhibiting water quality and use impairment problems. It may also help a fisherman locate the most likely fish habitat.

Generally, from the surface to between two and five times the Secchi disc depth can be considered the euphotic (lighted) zone of the lake; in this region there is enough light to allow plants to survive and produce oxygen by photosynthesis. This is also the zone of greatest fish activity. Waters below the euphotic zone can be expected to have little or no dissolved oxygen during the summer if the lake is thermally stratified (has layers of water of different temperatures). During this stratification period, fish will probably be limited to the euphotic or aerobic (oxygenated) zone of the lake.

In the absence of dissolved oxygen, substances such as hydrogen sulfide, ammonia, methane, phosphorus, iron, and manganese may accumulate in the bottom waters. These substances can contribute to serious taste and odor problems in drinking water if water supply is taken from near the lake bottom during summer stratification. When the substances which have accumulated in the bottom waters during stratification periods are distributed throughout the lake during mixing periods, they can trigger nuisance algal blooms, aquatic weed growth, taste and odor, and other water quality problems.

Much information on the problems, causes, and general water quality for a lake may be determined from the pattern in which its Secchi disc readings fluctuate during the monitoring season; from spatial differences in clarity within the lake; and from field observations of water color, amount of sediment, algae, and aquatic weeds, weather conditions, water levels, and lake management techniques undertaken.

The major pollutants that can be detected from the volunteer monitoring are sediment (which turns the water shades of brown or tan) and nutrients, which act like fertilizers and promote the growth of aquatic plants and algae (which turn the water green, greenish-brown, blue-green, or yellowish).

Seasonal differences in transparency are often apparent and can indicate the types and causes of problems in a lake. In the spring, rainfall is usually heaviest and cropland in the watershed often lacks plant cover, so suspended sediment resulting from soil erosion may turn the lake some shade of brown. The more suspended sediment, the browner the water and the shallower the Secchi disc reading will be.

Some lakes that have severe watershed or shoreline erosion problems remain brown year round, as do shallow lakes in which bottom sediment is resuspended by wave action or the activity of bottom feeding fish.

Other lakes may be brown from sediment during rainfall events, then turn green or greenish-brown from algae as the sediment settles out and allows enough light penetration for algae to use the available nutrients for growth. These lakes may be brown in spring and green in summer, or this pattern may repeat itself with rainfall events throughout the year.

Deeper lakes which have less incoming sediment from rainfall events are generally clearer in the springtime. They may remain relatively clear throughout the year, or they may exhibit algae blooms (population explosions of algae) which turn the water green and lessen the transparency. These blooms may be associated with the spring and fall circulation periods (when nutrients which have been trapped in the bottom waters during thermal stratification are distributed throughout the lake and become available for algae growth) or occur during the hot summer months.

Less rainfall during the summer and the development of crop cover in the watershed generally results in less erosion at the time, so a lake with primarily sediment problems may show some improvement. These lakes, as well as those that were relatively clear in the spring, may develop algae blooms during the summer if there is nutrient pollution present.

By the end of September or beginning of October, algae populations often become smaller as water temperatures decrease. The Secchi disc readings will often become deeper again unless soil erosion from increased autumn rainfall increases the sediment input or circulation of nutrients throughout the lake during fall turnover promotes algae blooms.

Locating those areas of the lake that have the lowest Secchi disc transparency and are the brownest or greenest can indicate where sediment and nutrients are most likely entering the lake. Generally, three or more sites are monitored to evaluate spatial differences in transparency within the lake. In reservoirs created by damming streams, for example, a large sediment and nutrient load may be carried in by inflowing streams. The sediment turns the water brown, and the nutrients promote the growth of algae which turn it green or greenish-brown; both lessen the water clarity. The sediment generally settles out in the lake headwaters (upper end, where tributaries enter) and the water tends to become clearer towards the dam. As the sediment settles out, algae often become more apparent and turn the water green to greenish brown nearer the dam.

Secchi disc transparency is a quick and easy measure which integrates many important features of a lake system. Secchi disc readings combined with field observations provide an indication of the amount of usable habitat available for fish and other aquatic life; the lake productivity; and the general water quality, problems and causes.

Consistent monitoring and observations throughout the sampling season as well as over a period of years are necessary to identify problems and causes, document water quality trends, and evaluate lake and watershed management strategies.

METHODS

Obtaining Volunteers

An invitation to citizens to volunteer for the 1981 Lake Monitoring Program appeared in general publications, the Illinois Department of Conservation magazine "Outdoor Highlights," the newsletter of the Water Resources Center, the IEPA magazine "Progress" and the Illinois Wildlife Federation publication. Invitations were also sent to the environmental and conservation contacts on the IEPA mailing lists. The program was advertised at speaking engagements and a poster display was prepared. Letters requesting participation in the program were mailed to public water supply operators of surface water impoundments. The Illinois Department of Conservation was also contacted.

The Secchi disc, calibrated braided nylon rope, fact and instruction sheets, data forms, postage paid return envelopes and an identification card were provided by the Illinois EPA. The volunteers were expected to have a boat with an anchor and the safety equipment specified by the Illinois Department of Conservation boating regulations. Volunteers were also asked to provide a lake map and information regarding lake morphology, uses, water quality conditions, watershed uses, and potential pollution sources (see Lake Assessment Form, Appendix A).

Participants

More than 200 volunteers offered to monitor lakes. However, because there were only 100 Secchi discs available, the program had to be limited. Volunteers were accepted on a first-come, first-serve basis to monitor 104 lakes for the 1981 program. Some volunteers monitored more than one lake, while many lakes had more than one volunteer who shared the Secchi disc.

Lakes

Eighty-seven of the 104 lakes originally selected were sampled at least once. These lakes are located in Figure 2 and identified by a three to four letter map code (lake names corresponding to map codes are given in Table 1). Participants in the 1981 VLMP are listed in Appendix B. Lake monitoring sites are described in Appendix C.

The lakes were grouped by Public Participation Region (see Figure 3). The distribution of the 87 lakes among the Public Participation Regions is shown in Figure 4a. A number of lakes were concentrated in the Chicago area; however, a statewide representation was obtained.

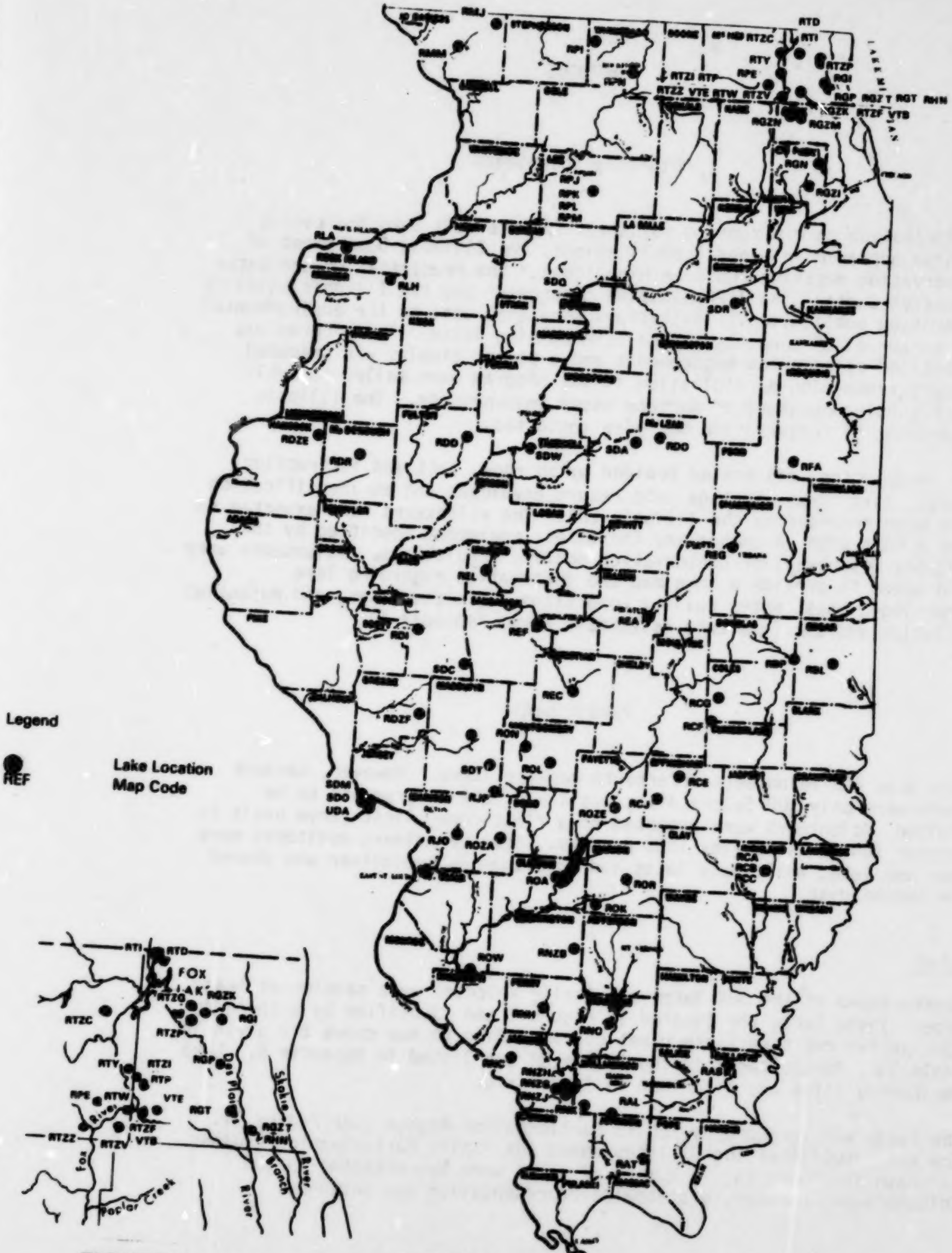
Legend
REF
Lake Location Map Code
FOX LAKE
Des Plaines River
Skokie River
Fox River
Poplar Creek
LAKE MICHIGAN

FIGURE 2. Location of 87 lakes included in the Illinois EPA Volunteer Lake Monitoring Program, 1981.

TABLE 1. BACKGROUND INFORMATION FOR 87 LAKES, ILLINOIS EPA, VOLUNTEER LAKE MONITORING PROGRAM, 1981

LAKE NAME	COUNTY	LAKE CODE	MAP CODE	SURFACE AREA (ACRES)	MAXIMUM DEPTH (FT.)	AVERAGE DEPTH (FT.)	STORAGE CAPACITY (ACRE-FT.)	WATERSHED AREA (ACRES)	LAKE TYPE	YEAR CONST.	OWNERSHIP	PUBLIC ACCESS	MAJOR USE
CHICAGO REGION													
Arbor	DuPage	RG-A08ZI	RGZI	14.7	25	17	250	50	Borrow pit	1957	Org.	no	recr.
Briarwood	DuPage	RG-A07-N	RGN	13	12	5	65	-	Dammed-Ginger Cr.	1968	Briarwood Comm. Assn.	no	recr.
*Catherine	Lake	RT-B01-D	RTD	147	42	16.7	2,458	757,760	Glacial	-	Public	yes	recr.
*Channel	Lake	RT-B01-I	RTI	319	35	13.8	4,400	757,760	Glacial	-	Public	yes	recr.
*Crystal	McHenry	RP-B03-E	RPE	234	41	15.9	3,729	3,200	Glacial	-	Prop. Owners	yes	recr.
*Dog Bone	Lake	VT-B02-B	VTB	16	16	5	80	200	Dammed stream	-	Stone Enterprises	no	
Duck	Lake	RT-B01-G	RTG	92	8	3.8	350	1,195	Glacial	-	Org. Prop. Owners	no	recr.
Gages	Lake	RG-B01-I	RGI	139	60	10.6	1,473	1,280	Glacial-dammed	-	Public	yes	recr.
*Griswold	McHenry	RT-B02-Y	RTY	144	12	7.1	1,001	1,050	Glacial	-	Org.	yes	recr.
Highland	Lake	RT-B01ZP	RTZP	110	35	10.3	1,113	700	Glacial	-	Prop. Owners Assn.	no	recr.
Indian Knoll	Lake	VT-B02-E	VTE	1	12	4.0	4	10	Dug	1967	F.J. Foersterling	no	recr.
Inverness (Pheasant)	Lake	RG-B02ZN	RGZN	16	10	5.0	80	-	Dug	1965	L. Inverness Prop. owner Assn.	yes	recr.
Island	Lake	RT-B02ZI	RTZI	78	10	4.4	347	1,500	Dammed-Mutton Cr.	-	Org.	yes	recr.
Killarney	McHenry	RT-B02ZV	RTZV	57.5	40	6	345	-	Spring-fed	-	Org.	no	recr.
Lake-In-The-Hills	McHenry	RT-B03ZZ	RTZZ	54	30	8	432	-	Dammed-Woods Cr.	-	Lake-In-The-Hills Assn.	yes	recr.
Liberty	Lake	RG-B02-T	RGT	30	19	7	210	-	Quarry	1935	Private	no	recr.
Minear	Lake	RG-B01-P	RGP	64	25	15	960	345	Quarry	1930	L. Minear Cons. Assn.	no	recr.
Potomac	Lake	RG-B02ZK	RGZK	14	-	-	-	-	Dammed marsh	1976	Vill. of Lindenhurst	yes	recr.
Silver	McHenry	RT-B02-W	RTW	40	20	14	560	-	Dammed stream	1950	Vill. of Oakwood Hills	no	recr.
Slocum	Lake	RT-B02-P	RTP	215	9	4	860	5,585	Dammed-glacial	-	Org.	yes	recr.
Spring	Lake	RG-A01ZT	RGZT	1.5	20	10	15	-	Spring-fed &pumped	-	Municipal	yes	recr.
Sutton Place	Lake	RH-B01-N	RHN	1	-	4	4	-			private	no	recr.
Tower	Lake	RT-B01ZF	RTZF	88	9	4	352	-	Dammed stream	1977	Org.	no	recr.
Valley	Cook	RG-B01ZM	RGZM	4	9.0	5.0	20	500	Dammed stream	1946	Org.	no	recr.
Wonder	McHenry	RT-B01ZC	RTZC	730	13.0	6.4	4,672	62,720	Dammed-Nippersink Cr.	1925	Prop. Owners Assn.	no	recr.
NORTHWEST REGION													
Apple R. Canyon	JoDaviess	RM-A01-J	RMJ	480	70	30.0	14,400	13,000	Dammed-Hells Br.	1969	Org.	no	recr.
Bass	Lee	RP-A06-J	RPJ	26	14	10.0	270	-	Dammed stream	-	Woodhaven Assn.	no	recr.
Black Oak	Lee	RP-A06-K	RPK	6.5	6.0	-	-	-	Dammed stream	-	Woodhaven Assn.	no	recr.

TABLE 1. BACKGROUND INFORMATION FOR 87 LAKES, ILLINOIS EPA, VOLUNTEER LAKE MONITORING PROGRAM, 1981 (CONTINUED)

LAKE NAME	COUNTY	LAKE CODE	MAP CODE	SURFACE AREA (ACRES)	MAXIMUM DEPTH (FT.)	AVERAGE DEPTH (FT.)	STORAGE CAPACITY (ACRE-FT.)	WATERSHED AREA (ACRES)	LAKE TYPE	YEAR CONST.	OWNERSHIP	PUBLIC ACCESS	MAJOR USE
Fyre	Mercer	RL-B01-H	RLH	165	36	14.0	2,310	1,082	Dammed stream	1970	Org.	no	recr.
Galena	JoDaviess	RM-B01-M	RMM	220	60	20.0	4,400	-	Dammed Smallpox Cr.	1974	Branigar Org.	no	recr. IWS
*George	Rock Is.	RL-B01-A	RLA	167	58	22.8	3,805	4,740	Dammed- Big Br. Cr.	1966	Pub.-Rock Is. Forest P.	yes	recr.
Main	Grundy	SD-B01-R	SDR	-	25	12	-	-	Coal strip mine	1930	Org. BSA Rainbow Con.	no	recr.
Spring	Winnebago	RP-B02-N	RPN	9.8	12	7	69	-	Dammed	1965	Prop. Owners Assn.	no	recr.
Summerset	Stephenson /Winnebago	RP-A06-I	RPI	301	40	18	5,418	4,500	Dammed- Otter Cr.	1970	L. Summerset Assn.	no	recr.
Sunset	Lee	RP-A06-L	RPL	7	10	6	44	-	Dammed stream	1974	Woodhaven Assn.	no	recr.
Thunderbird	Putnam	RT-B02ZY	RTZY	112.9	60	35	3,951	16,000	Dammed stream	1970	Org.	no	recr. AWS
Woodhaven	Lee	RP-A06-M	RPM	27	30	8	209	-	Dammed stream	1976	Woodhaven Assn.	no	recr.
EAST CENTRAL REGION													
*Bloomington	McLean	RD-A03-O	RDO	635	35	14	8,800	45,440	Dammed- Money; Hickory Cr.	1929; 1958	Pub.-City of Bloomington	yes	PWS; recr
Carlyle	Clinton	RL-B01-L	RLL	26,000	40	10.9	283,000	1,738,880	Dammed- Kaskaskia R.	1967	Pub.-U.S. Army Corps of Eng.	yes	PWS; recr. IWS & AWS
*Decatur	Macon	RE-B02-A	REA	3,093	23	7.2	22,270	597,497	Dammed- Sangamon R.	1922	Pub.-City of Decatur	yes	PWS; IWS; recr.
*Evergreen	McLean	SD-A03-A	SDA	700	48	17.0	12,125	25,728	Dammed- Six Mile Cr.	1970	Pub.-City of Bloomington	yes	PWS; IWS, AWS, recr
Iroquois	Iroquois	RF-A01-A	RFA	125	22	8	1,000	640	Dammed stream	1970	Lake Iroquois Assn.	no	recr
Lake-of-the Woods	Champaign	RE-B01-G	REG	23	22	9.7	225	609	Dammed stream	1948	Champaign Co. F.P. Dist.	yes	recr irrg
*Mattoon	Coles	RC-A09-F	RCF	1,028	35	11.3	11,660	35,480	Dammed- L. Wabash R	1959	Pub.-City of Mattoon	yes	PWS; recr
*Oakland	Coles	RB-A05-P	RBP	26	9.5	5.1	134	9,158	Dammed- Hogue Br.	1937	Pub.-City of Oakland	yes	PWS, AWS; recr
*Paradise	Coles	RC-A09-G	RCG	166	23	8.5	1,407	11,585	Dammed- L. Wabash	1909	Pub.-City of Mattoon	yes	PWS; IWS; recr
*Paris W.	Edgar	RB-A04-L	RBL	56.7	8.5	3.3	187	11,328	Dammed- Sugar Cr.	1898	Pub.-City of Paris	yes	PWS; IWS; AWS; recr
*Paris E.	Edgar	RB-A04-L	RBL	162.6	26.5	10.2	1,660	12,800	Dammed- Sugar Cr.	1917; 1960	Pub. City of Paris	yes	PWS; IWS; AWS; Recr

TABLE 1. BACKGROUND INFORMATION FOR 87 LAKES, ILLINOIS EPA, VOLUNTEER LAKE MONITORING PROGRAM, 1981 (CONTINUED)

LAKE NAME	COUNTY	LAKE CODE	MAP CODE	SURFACE AREA (ACRES)	MAXIMUM DEPTH (FT.)	AVERAGE DEPTH (FT.)	STORAGE CAPACITY (ACRE-FT.)	WATERSHED AREA (ACRES)	LAKE TYPE	YEAR CONST.	OWNERSHIP	PUBLIC ACCESS	MAJOR USE
WEST CENTRAL REGION													
*Canton	Fulton	RD-B05-D	RDD	247	33	13	3,211	9,659	Dammed-W. Br. Copperas Cr.	1939; 1972	Pub.-City of	yes	PWS; recr.
*Glen Shoals	Montgomery	RO-A01-L	ROL	1,350	30	8.0	10,800	750,000	Dammed-M.Fk. Shoal Cr.	1978	Pub.-City of Hillsboro	yes	PWS; recr.
*Gillespie	Macoupin	SD-A02-T	SDT	71	19	9.8	696	3,665	Dammed-Dry Fork	1924	Pub.-City of Gillespie	yes	PWS; recr.
Old *Greenfield	Greene	RD-A06ZF	RDZF	40	25	10.0	401	654	Dammed T. Rubican	1959	Pub.-City of Greenfield	yes	PWS; recr.
*Jacksonville	Morgan	RD-B06-I	RDI	476.5	36	12.8	6,099	6,880	Dammed-Sandy Cr.	1939	Pub.-City of Jacksonville	yes	recr. PWS
*LaHarpe	Hancock	RD-A05ZE	RDZE	9.2	15	10.0	92	65	Dammed-Crooked Cr.	1945	Pub.-City of LaHarpe	yes	PWS recr.
*Lou Yaeger	Montgomery	RD-A03-N	RDN	1,268.5	40.5	10.7	13,573	73,600	Dammed-Shoal Cr.	1966	Pub.-City of Litchfield	yes	PWS, IWS, recr.
Northern Oaks	Tazewell	SD-B05-W	SDW	38	52	20.0	760	1,000	Dammed-U. Lick Cr.	1959	N. Oaks Home-Owners Assn.	no	PWS; recr.
Petersburg	Menard	RE-B06-L	REL	191	65	24.0	4,584	1,400	Dammed stream	1967	L. Peters-burg Assn.	no	recr.
Pohlman	Calhoun	UD-B06-A	UDA	95	4	2.5	285	-	River backwater	-	Public	yes	recr.
Royal	Calhoun	SD-B02-O	SDO	68	4	2.5	204	-	River backwater	-	Public	yes	recr.
*Spring	McDonough	RD-A05-R	RDR	277	35	10.4	2,881	12,928	Dammed-Spring Cr.	1927, 1969	Pub.-City of Macomb	yes	PWS; IWS, recr.
*Springfield	Sangamon	RE-A05-F	REF	4,024	40	13.0	53,478	165,366	Dammed-Lick Cr., Sugar Cr.	1935	Pub.-City of Springfield	yes	PWS, IWS, CW, recr.
Staunton Sportsmen's	Macoupin	RJ-A02-P	RJP	9	13	9	81	150	Dammed stream	1903	Staunton Sptm's Club	no	AWS, recr.
Swan	Calhoun	SD-B02-M	SDM	2,345	5	2.5	7,035	-	River backwater	-	Public	yes	recr.
*Taylorville	Christian	RE-A04-C	REC	1,148	19	6.9	7,914	84,032	Dammed-S. Fk. Sang.	1962	Pub.-City of Taylorville	yes	PWS, recr.
*Waverly	Morgan	SD-B06-C	SDC	59	12	6.0	354	5,914	Dammed-Woods Cr.	1938	Pub.-City of Waverly	yes	PWS, recr.
SOUTHERN REGION													
*Altamont New	Effingham	RC-A09-J	RCJ	57	38	20	1,140	685	Dammed-Turkey Cr.	1973	Pub.-City of Altamont	no	PWS, AWS
*Ashley	Washington	RN-B01ZB	RNZB	18	16	8.0	144	796	Dammed stream	1941	Pub.-City of Ashley	yes	PWS, IWS, AWS, recr.
*Baldwin	St. Clair	RO-B05-W	ROW	1,967	48	10	19,670	3,113	Man-made	1972	IL Power Co.	yes	cool-ing recr.
*Benton	Franklin	RN-B01-O	RNO	37	23	6.0	222	640	Dammed stream	1937	Public	yes	recr.

TABLE 1. BACKGROUND INFORMATION FOR 87 LAKES, ILLINOIS EPA, VOLUNTEER LAKE MONITORING PROGRAM, 1981 (CONTINUED)

LAKE NAME	COUNTY	LAKE CODE	MAP CODE	SURFACE AREA (ACRES)	MAXIMUM DEPTH (FT.)	AVERAGE DEPTH (FT.)	STORAGE CAPACITY (ACRE-FT.)	WATERSHED AREA (ACRES)	LAKE TYPE	YEAR CONST.	OWNERSHIP	PUBLIC ACCESS	MAJOR USE
*Borah	Richland	RC-A09-B	RCB	137	32	11.0	1,517	2,154	Dammed-E. Fk. Fox R.	1953	Pub.-City of Olney	yes	recr. PWS, AWS
*Campus	Jackson	RA-A07ZH	RAZH	40	14	8.0	320	384	Dammed streams	1880, 1957	Pub.-So. IL. Univ.	yes	recr.
*Highland Silver	Madison	RO-A04ZA	ROZA	598.4	26.2	10.6	6,336	30,976	Dammed-Silver Cr.	1961	Pub.-City of Highland	yes	PWS, recr.
*Kinkaid	Jackson	RN-A08-C	RNC	2,750	80	28.7	78,925	42,336	Dammed-Kinkaid Cr.	1971	Kinkaid-Reeds Cr. Cons. Dist.	yes	PWS, IWS, AWS, recr.
*Lake of Egypt	Johnson	RA-A03-L	RAL	2,300	52	18.5	42,550	17,000	Dammed-S. Fk. Saline R.	1962	So. IL Power Coop.	yes	cooling; recr; PWS
*Little Grassy	Williamson	RN-A06-K	RNK	1,000	77	25.7	25,740	9,664	Dammed-L. Grassy Cr.	1950	Pub.-USFWS	yes	recr.
*Olney E. Fork	Richland	RC-A09-C	RCC	935	40	15.0	14,000	9,982	Dammed-E. Fork Fox R.	1971	Public	yes	PWS, IWS
*Omaha	Gallatin	RA-A01-S	RAS	26	16	7.0	184	154	Dammed-stream	1964	Pub.-City of Omaha	yes	PWS, recr.
*Pinckneyville	Perry	RN-A04-H	RNH	165	30	12.0	1,980	3,051	Dammed-Opposum Cr.	1945	Pub.-City of Pinckneyville	yes	PWS, IWS, AWS, recr.
*Raccoon	Marion	RO-A02-K	ROK	763	16	6.0	4,578	30,974	Dammed-Raccoon Cr.	1943	Pub.-City of Centralia	yes	PWS, recr.
*Salem	Marion	RO-A02-R	ROR	74	14	7.2	531	2,573	Dammed-Town Cr.	1911	Pub.-City of Salem	yes	PWS, recr.
*Sara	Effingham	RC-A09-E	RCE	760	55	18.0	13,600	7,900	Dammed-Blue Ft. Cr.	1957	Pub.-Effingham Water Authority	yes	PWS, recr.
Spring Arbor	Jackson	RN-A07ZG	RNZG	100	50	12.0	1,200	500	Dammed-Indian Cr.	1965	Org.	no	recr.
Stanberry	Fayette	RO-B03ZE	ROZE	12	10	5	60	300	Dammed stream	1945	Tenshore, Inc	no	recr.
Thompson Fishing Club	Jackson	RN-B03ZJ	RNZJ	20	25	10	200	75	Dammed stream	1958	Thompson Fishing Club	no	recr.
*Tower	Madison	RT-B01ZF	RTZF	77	30	17	1,309	700	Dammed stream	1964	Pub.-SIU Edwardsville	yes	PWS IWS; recr.
*Vernor	Richland	RC-A09-A	RCA	36	27	15	540	300	Dammed stream	1927	Pub.-City of Olney	yes	recr.
Vienna Corr. Center	Johnson	RA-B03-T	RAT	70	24	12.0	8,400	500	Dammed T-Bay Cr.	1964	State-Vienna Corr. Center	no	recr. PWS

DS:ct/3413C,spl-4

* Lakes sampled by the Illinois EPA in 1981 under the Ambient Lake Monitoring Program

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
PUBLIC PARTICIPATION COORDINATORS - 1981

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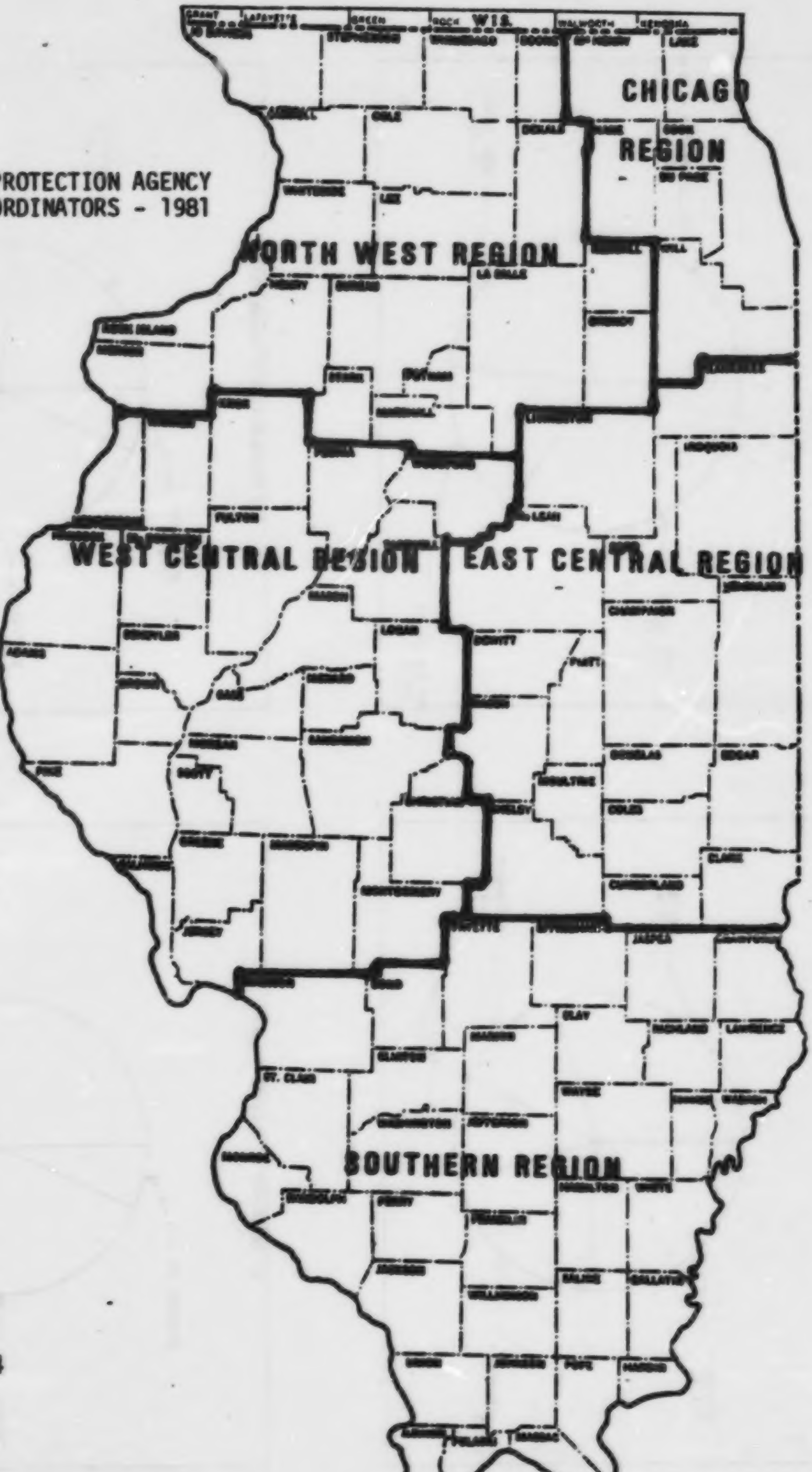
WIS.
CHICAGO REGION
NORTH WEST REGION
WEST CENTRAL REGION
EAST CENTRAL REGION
SOUTHERN REGION

FIGURE 3. Illinois Environmental Protection Agency, Public Participation regions, 1981.

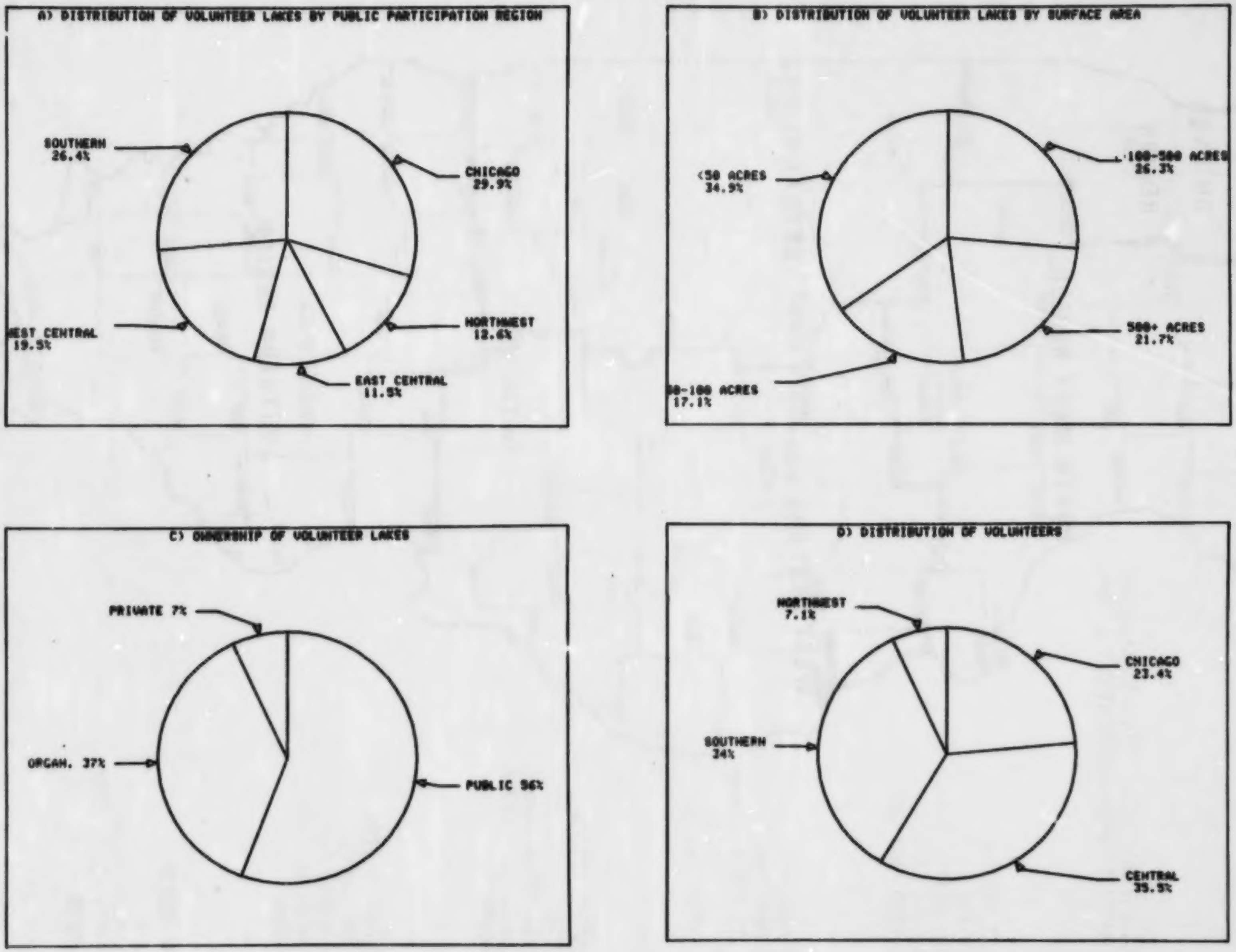

FIGURE 4. Illinois EPA Volunteer Lake Monitoring Program, 1981, distribution: a) of lakes by Public Participation region; b) of lakes by surface area categories; c) of lakes by ownership classification; d) of volunteers by Public Participation region.

Data on morphology, ownership, and use of the 87 lakes remaining in the program are included in Table 1. The size distribution of lakes included in the program was about evenly divided between those less than 100 acres and those which were more than 100 acres in surface area (Figure 4b). Approximately three-fourths of the water bodies were impounding reservoirs created by damming streams. Most were shallow; about three-fourths had mean depths less than 15 feet and 60 percent had maximum depths less than 30 feet.

A little over one-half of the lakes were publicly owned, while about one-third were owned by organizations (Figure 4c). The number of publicly owned lakes varied greatly by region; in the Chicago and Northwest regions, 28% and 9%, respectively, were public; while in central and southern Illinois, more than three-fourths were public. About two-thirds of the public lakes were owned by municipalities. Sixty-one percent of all the lakes had public access.

The percent of lakes used for various water supply and recreational purposes is illustrated in Figure 5. Thirty-seven percent of the lakes were potable water supplies, 94% were used for fishing, and 87% were used for row boating. Swimming and power boating were uses specified for a little over half of the lakes. The amount of various recreational uses is depicted by pie diagrams in Figure 6.

Volunteers

The 141 volunteers who actually participated in monitoring were located statewide: 33 from the Chicago region, 10 from the Northwest, 50 from the Central region, and 48 from the Southern region (Figure 4d). Many of the volunteers were lake shore residents. They were also lake owners/managers, sportsmen, members of environmental groups or soil and water conservation districts, and interested citizens. Volunteers for 23 of the lakes were the Public Water Supply Operators.

Training Volunteers

The training of volunteers was conducted by six Agency Regional Public Participation Coordinators, who were first instructed by Division of Water Pollution Control Ambient Monitoring Unit staff. The training of Coordinators included information on program rationale, the use of a Secchi disc, data form completion, lake morphometry, designation of sampling sites, and methods for training volunteers.

Regional Public Participation Coordinators scheduled volunteer training for the lakes in their region during April and May, 1981. Generally, the training took place at the volunteer's lake, although some group trainings were scheduled in the Chicago area.

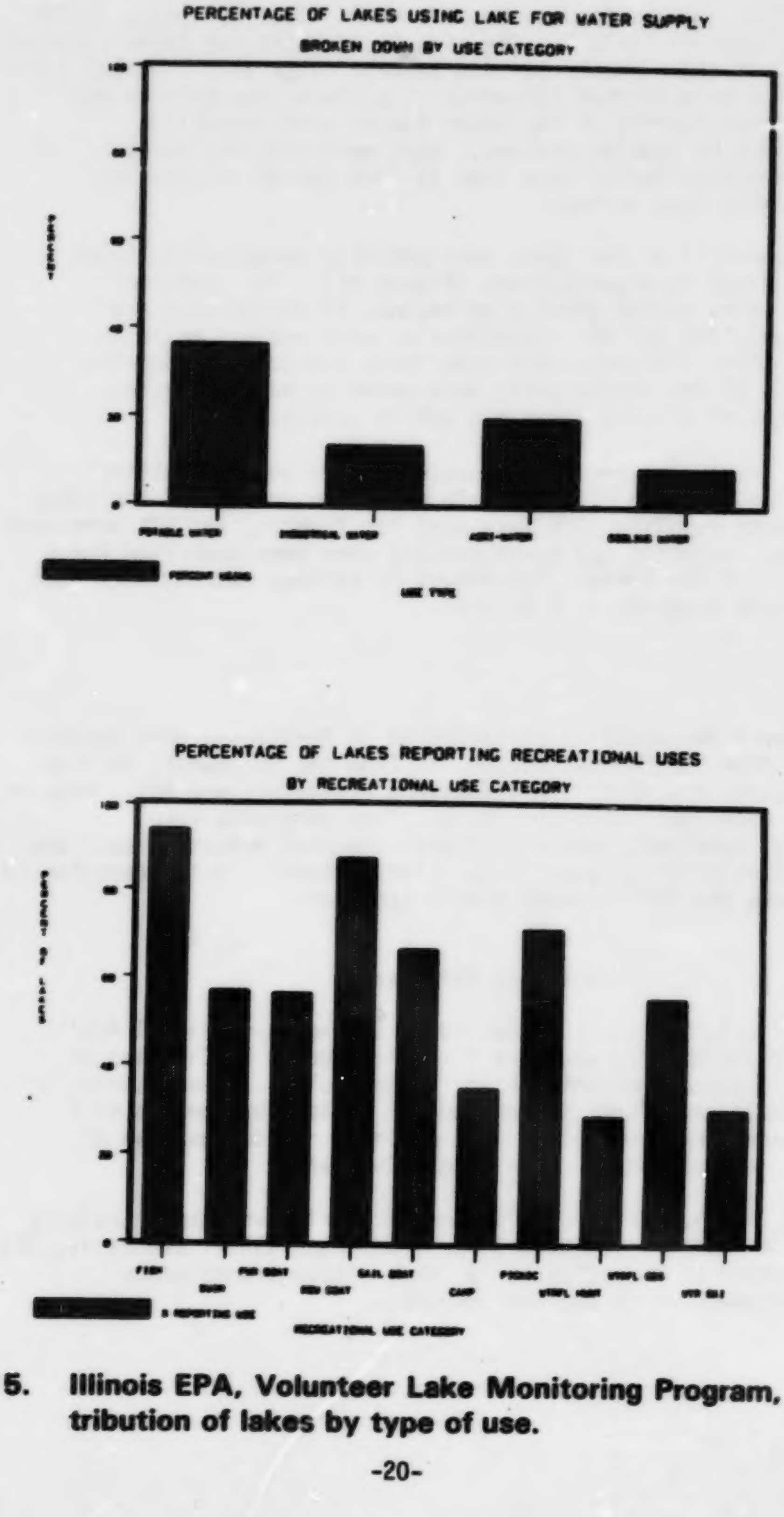

FIGURE 5. **Illinois EPA, Volunteer Lake Monitoring Program, 1981, distribution of lakes by type of use.**

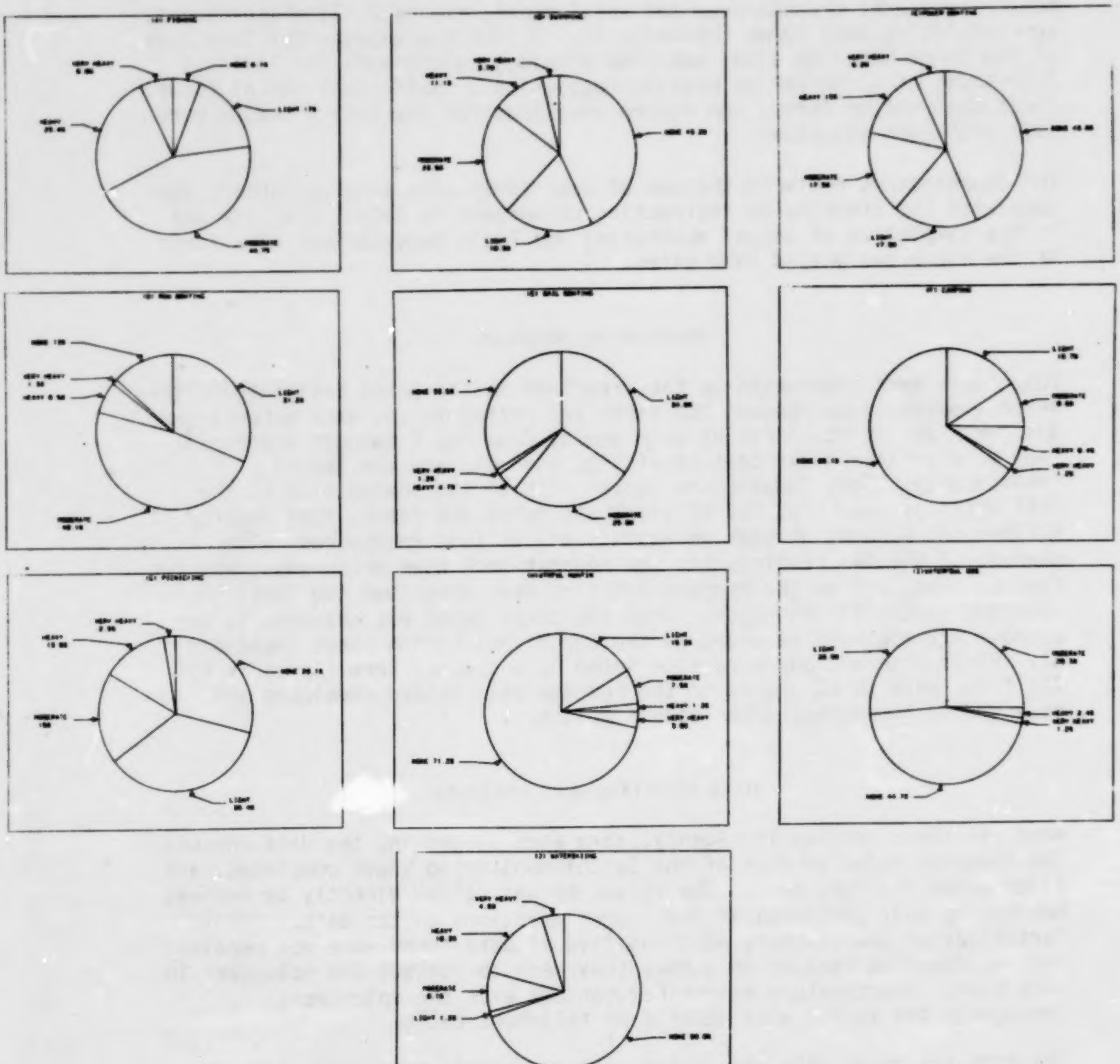

FIGURE 6. **Type and amount of recreational use for lakes in the Illinois EPA Volunteer Lake Monitoring Program, 1981.**

At the training, the volunteers were asked to sign a waiver of liability and an equipment loan form (see Appendix A). They were given a Fact Sheet which described the program and contained detailed instructions on measuring Secchi transparency and total depth, making field observations, and completing data forms (Appendix A). A lake map showing the locations of the three sampling sites was also provided, along with the Illinois Department of Conservation boating regulations. Sufficient Secchi forms, field observation forms, and return envelopes for the entire season were left with each volunteer.

The Coordinators reviewed the use of data forms with each volunteer, then completed the training by instructing volunteers in Secchi disc use and in the completion of Secchi Monitoring and Field Observations data forms at the three designated lake sites.

Monitoring Methods

Volunteers were instructed to take readings at the three designated sites twice a month (once between the first and fifteenth and once between the sixteenth and thirty-first of each month) from May 1 through October 31. They were to anchor the boat carefully, then measure the Secchi transparency. They lowered the Secchi disc on the shaded side of the boat until it just went out of sight and noted the depth, then lowered it further and brought it back up again until it just reappeared. The average of the two readings (to the nearest inch when measurement was two feet or less, and to the nearest 1/4 foot when more than two feet) was recorded as the Secchi depth. Then the total depth was measured to the nearest 1/2 foot and recorded on the Secchi Monitoring sheet (Appendix A). Field observations were also noted on a special form (Appendix A). The forms were to be placed in the postage paid return envelopes and returned to the Agency after each sampling.

Data Handling and Analysis

When the forms reached the Agency, they were logged in, the data checked, the computer coded portion of the Secchi monitoring sheet completed, and filed under the lake name. The volunteer was called directly by Ambient Monitoring Unit personnel if there were questions on the data. Public Participation Coordinators were notified if data forms were not received for two sampling periods in a row; they were to contact the volunteer in this case. Coordinators maintained contact with the volunteers throughout the season with letters or telephone calls.

The computer coded data were typed onto a magnetic tape using the Tektronix desk top computer terminal. Programs were written by Dr. David Schaeffer and Vladimir Chernomordikov to transfer the data to STORET as well as to analyze the data and produce graphs, tables, and statistical summaries. The lake assessment information and field observations provided by the volunteer were summarized in tabular form. The volunteer's lake assessment information was compared with other sources (primarily that provided by the Illinois Department of Conservation in 1977); the best available information was summarized on the lake assessment form. In addition to this summary report, individual reports were written for each lake sampled.

Special Monitoring

Special volunteer monitoring programs were established at Lake Decatur and Lake Springfield to correspond with the Sangamon River Basin study being conducted by Illinois EPA, Illinois Department of Conservation, and U.S. Geological Survey personnel. At Lake Decatur, Secchi readings were taken daily in June and July by the Lake Patrol and water samples collected from the water surface once a week. At Lake Springfield, the readings were taken approximately twice a week and water samples collected once a week by Springfield Department of Public Property employees. Water samples were transported to the Illinois EPA Champaign laboratory by Agency personnel.

Special volunteer monitoring was also conducted at Lake Kinkaid and Lake Sara to help assess the effectiveness of agricultural Resource Management Systems (RMS's) being installed on the watershed and to provide information to guide the implementation of additional RMS's. Secchi readings were to be taken on seven to eight lake sites for three days following each storm event (rainfall accumulation of more than one inch) in addition to the regular readings twice a month. Special reports, "Water Quality Assessment of Lake Kinkaid, Jackson County, Illinois, 1977-1981," and "Water Quality Assessment of Lake Sara, Effingham County, Illinois, 1977-1981" (Sefton and Little, 1982) were written incorporating the volunteer's monitoring data.

Many of the lakes in the volunteer program were also included in the Agency's Ambient Lake Monitoring Program. These lakes are indicated by an asterisk in Table 1. Water samples were collected from the three lake sites in May or June and August or September for analyses of physical, chemical and biological parameters. This data was summarized and analyzed in the Illinois Water Quality Inventory Report 1980-1981 (Illinois EPA, 1982).

Certificates of Appreciation

At the end of the sampling season, all volunteers were sent thank you letters for their participation in the program. Those volunteers for lakes with monitoring data for more than half of the sampling periods were sent Certificates of Appreciation signed by the Agency Director (see Appendix A). Reports were distributed to volunteers in June and July, 1982.

RESULTS AND DISCUSSION

Evaluation of Data Returns

A total of 104 lakes were selected for the 1981 Volunteer Lake Monitoring Program. Data returns for each lake are summarized in Appendix D. Monitoring data was not received for 17 lakes; these were considered to have dropped from the program. Of the 87 lakes with data, 59.6% of all possible Secchi disc samplings were performed (Table 2). This percentage varied by region; in central and southern Illinois, about two-thirds of all possible Secchi readings were taken, while in the Northwestern region only 44 percent were taken (see Figure 7a). Two-thirds of the 87 lakes had data for six or more sampling periods; this varied from 50 percent for the Northwest to 83 percent for the Southern region (Figure 7a).

The greatest percentage of returns (77%) were recorded for the second sampling period (May 16-31), reflecting high interest at the beginning of the program (see Figure 7b). Several volunteers began in the program but then dropped out after one or two samplings. There was a dramatic decrease after Labor Day, coinciding with the end of the heavy recreational use season. The lowest data returns (42%) were recorded during the October 15-31 sampling period.

The following 15 lakes had a 100 percent data return (i.e., were sampled during all 12 sampling periods): Griswold and Potomac in the Chicago region; George in the Northwest region; Lake of the Woods and Oakland in the East Central region; Lou Yaeger, Petersburg, Taylorville, and Waverly in the West Central region; and Ashley, Campus, Carlyle, Kinkaid, Pinckneyville, and Salem in the Southern region. Six of these lakes were sampled by Public Water Supply Operators.

The returns for Public Water Supply Operators were better than for the overall population. Three-fourths of all possible Secchi disc samplings were performed, while 78 percent of the 23 lakes monitored by Public Water Supply Operators had data for six or more sampling periods.

Monitoring Results

In this Section, the 1981 monitoring season results will be summarized for all the volunteer lakes. The individual lake data are presented and discussed in a separate report for each of the 87 lakes in the program.

TABLE 2. EVALUATION OF VOLUNTEER LAKE MONITORING PROGRAM DATA RETURNS, 1981.

	Original	Remaining					Lakes Sampled Six or More Times	
Region	Number of Lakes	Number of Lakes	Number Possible Samples	% of Original Remaining	No. of Samples Obtained	% of Samples Taken for Remaining Lakes	Number of Lakes	% of Remaining
Chicago	35	25	300	71.4	151	50.3	15	60.0
North West	13	12	144	92.3	63	43.8	6	50.0
East Central	10	10	120	100.0	77	64.2	6	60.0
West Central	21	12	204	81.0	143	70.1	13	76.5
Southern	25	23	276	92.0	188	68.1	19	82.6
Total	104	87	1044	83.7	622	59.6	59	67.8

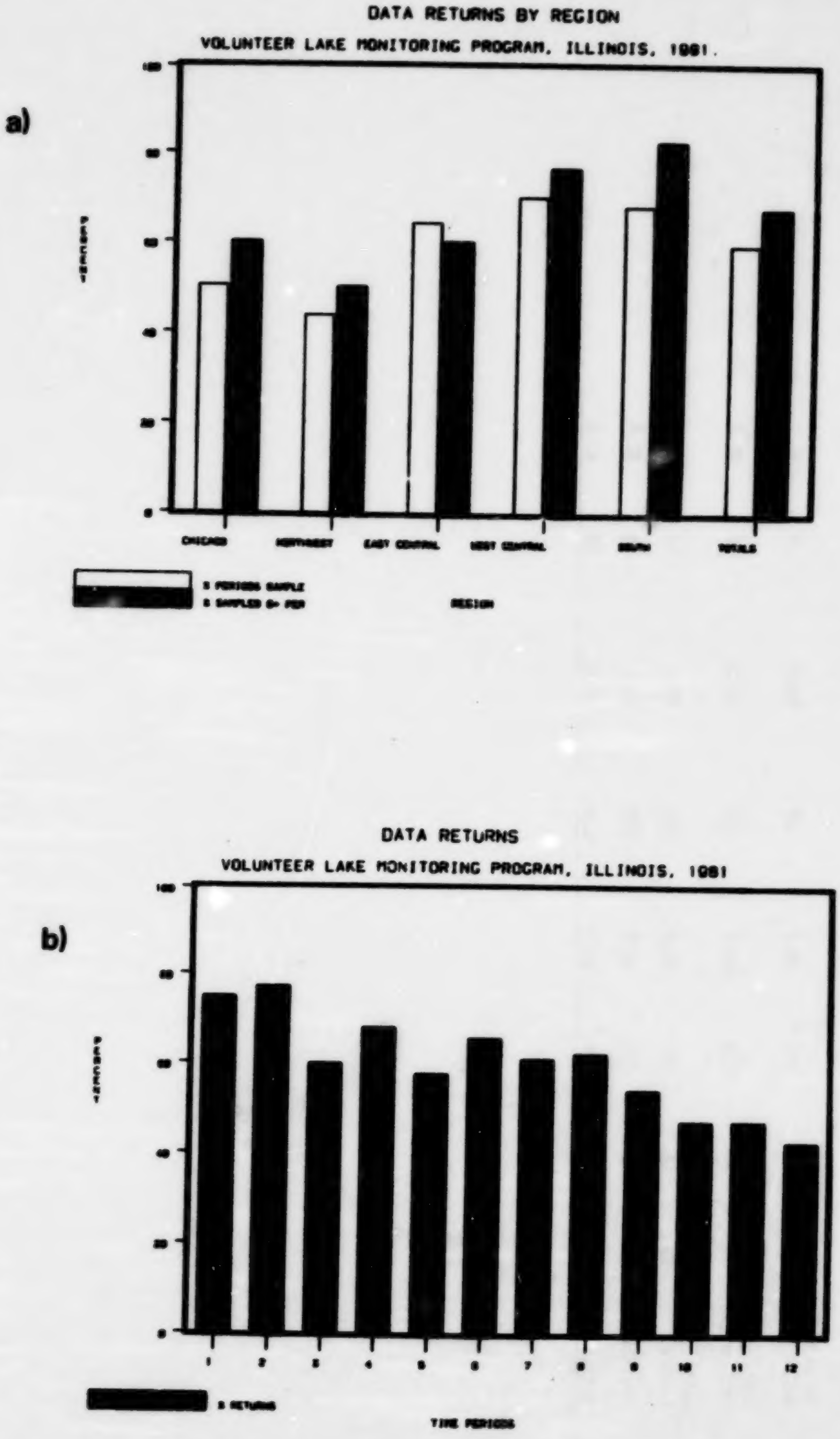

FIGURE 7. Evaluation of data returns for Illinois EPA Volunteer Lake Monitoring Program: a) by Public Participation region; b) by sampling period.

Summary and Ranking of Data

The average, minimum, and maximum Secchi values recorded and the number of observations recorded for each lake are summarized in Table 3. Lake management techniques used which may affect readings are also noted. Copper sulfate or cutrine was used as an algicide on 26, or 30%, of the lakes.

Each lake was also assigned a rank based on average Secchi transparency (see Table 3 and Fig. 1). The lake with the highest average transparency of 137.9 inches (Arbor in DuPage County, a borrow pit) ranked number 1, while the lake with the lowest average of 7.3 inches (Royal in Calhoun County, an Illinois River backwater) ranked number 87.

Categorization

The lakes were divided into four major categories by average Secchi disc transparency: 1 = less than 24 inches; 2 = 24 to less than 48 inches; 3 = 48 to less than 79 inches; and 4 = 79 or more inches. The number and percentage of lakes in each category is presented in the pie diagram of Figure 8. Sixty-three (or 72.4%) of the 87 lakes monitored had average transparencies less than four feet, the minimum recommended for bathing beaches by the Illinois Department of Public Health (1976). Approximately one-third of the lakes had average values less than two feet, the level generally associated with use impairment problems for Illinois lakes.

Each of the four categories was assigned a different symbol and plotted on the state map in Figure 8. Lakes with the greatest average transparencies are depicted by stars, while those with lowest transparencies are depicted by squares. The clearest lakes with the greatest average transparencies were generally located in northern and southern Illinois, while the most turbid lakes with the lowest transparencies were found primarily in the Central and South Central regions.

Figure 9 shows the number of lakes with average Secchi disc transparencies in each of 23 categories (six inch increments) between 0 and 138 inches, as well as summary statistics for all the volunteer data. The largest number of lakes fell in the range of 42-48 inches. The grand mean (standard deviation) Secchi disc transparency calculated from all the lake averages was 39.1 (± 26.2) inches; this was almost identical to the grand mean of 39.5 (∓ 28.1) inches calculated for the 65 ambient lakes sampled in 1980-81.

The average Secchi disc transparency aggregated by region is depicted in Figure 10. The Northwest and Southern regions had the highest average transparencies (60 and 45 inches, respectively) while East Central had the lowest (20 inches).

TABLE 3. SUMMARY OF VOLUNTEER LAKE MONITORING PROGRAM RESULTS, ILLINOIS EPA, 1981.

LAKE	COUNTY	MAP CODE	SECCHI DISC TRANSPARENCY AVG.	MIN.	MAX.	DEV.	NO. OF OBSERVA-TIONS	LAKE MGMT	TROPHIC STATE INDEX	SECCHI RANK
CHICAGO REGION										
Arbor	DuPage	RGZI	137.9	84	252	59.0	15	-	41.9	1
Briarwood	DuPage	RGN	16.0	6	34	6.4	33	-	73.0	71
Catherine	Lake	RTD	54.0	42	90	15.8	18	-	55.4	18
Channel	Lake	RTI	45.7	42	60	5.1	18	-	57.9	30
Crystal	McHenry	RPE	58.2	41	84	13.2	27	-	54.4	17
Dog Bone	Lake	VTB	25.9	14	42	11.1	15	-	66.0	53
Duck	Lake	RTZG	18.3	14	22	2.6	15	2,4-D	71.0	66
Gages	Lake	RGI	36.5	20	72	11.2	24	Weed Control	61.1	43
Griswold	McHenry	RTY	27.6	18	36	4.5	60	Weed Control	65.1	49
Highland	Lake	RTZP	65.9	48	102	14.3	51	Weed Control	52.6	15
Indian Knoll	Lake	VTE	26.5	12	54	8.2	27	Aquathol; $CuSO_4$	65.7	51
Inver (Pheasant)	Lake	RGZN	52.0	30	102	19.3	18	Weed Control	56.0	19-20
Island	Lake	RTZI	18.0	16	20	2.0	3	-	71.3	67
Killarney	McHenry	RTZV	25.7	22	30	2.9	6	-	66.1	54
Lake-in-the Hills	McHenry	RTZZ	38.9	24	60	10.5	21	-	60.2	41
Liberty	Lake	RGT	34.8	18	58	15.1	12	-	61.8	45
Minear	Lake	RGP	61.9	30	84	11.5	21	-	53.5	16
Potomac	Lake	RGZK	19.1	6	44	10.2	36	2,4-D; harvest	70.4	65
Silver	McHenry	RTW	52.0	30	78	16.0	24	Aquathol/Diquat	56.0	19-20
Slocum	Lake	RTP	8.0	6	12	1.6	30	-	83.0	85
Spring	Lake	RGZT	22.0	18	24	3.5	3	-	68.4	60
Sutton Place	Lake	RNN	24.0	24	24	0.0	3	-	67.1	56
Tower	Lake	RTZF	24.7	19	30	4.0	9	dye; 2,4-D	66.7	55
Valley	Cook	RGZM	48.3	30	66	9.8	12	-	57.1	23
Wonder	McHenry	RTZC	13.6	10	24	3.3	30	-	75.3	74-76
NORTHWEST REGION										
Apple Canyon	Jo Daviess	RMJ	47.3	20	78	18.9	6	Diquat, Cutrine	57.4	25
Bass	Lee	RPJ	42.6	6	102	23.9	30	Weed Harv.	58.9	37
Black Oak	Lee	RPK	49.0	45	54	4.6	3	-	56.8	22
Fyre	Mercer	RLN	84.0	78	90	6.0	3	-	49.0	7
Galena	JoDaviess	RMM	66.3	25	102	38.8	3	-	52.5	12-14
George	Rock Island	RLA	48.2	12	168	30.3	42	-	57.1	24
Main	Grundy	SDR	74.0	54	90	18.3	3	Aquacheck	50.9	10
Spring	Winnebago	RPN	22.1	14	34	5.8	21	$CuSO_4$	68.3	59
Summerset	Stephenson	RPI	66.6	10	132	30.3	33	Cutrine+	52.9	12
Sunset	Lee	RPL	81.2	48	96	14.5	30	Weed Harv.	49.6	9
Thunderbird	Putnam	SDQ	46.0	36	54	9.2	3	-	57.8	28-29
Woodhaven	Lee	RPM	99.1	24	177	39.0	27	Weed Harv.	46.7	3

TABLE 3. SUMMARY OF VOLUNTEER LAKE MONITORING PROGRAM RESULTS, ILLINOIS EPA, 1981 (CONTINUED).

LAKE	COUNTY	MAP CODE	SECCHI DISC TRANSPARENCY				NO. OF OBSERVATIONS	LAKE MGMT	TROPHIC STATE INDEX	SECCHI RANK
			AVG.	MIN.	MAX.	DEV.				
EAST CENTRAL REGION										
Bloomington	McLean	RDO	16.3	6	30	8.6	12	-	72.7	69
Carlyle	Clinton	ROA	10.2	5	15	3.1	35	-	79.5	79
Decatur	Macon	REA	8.5	3	27	4.4	125	-	82.1	84
Evergreen	McLean	SDA	23.3	16	30	7.0	3	-	67.6	57-58
Iroquois	Iroquois	RFA	35.2	24	42	3.5	29	-	61.6	44
Lake of the Woods	Champaign	REG	41.4	19	93	18.2	42	$CuSO_4$;Aquathol K	59.3	39
Mattoon	Coles	RCF	20.7	8	30	7.6	15	-	69.3	63
Oakland	Coles	RBP	13.6	6	24	4.1	36	$CuSO_4$	75.3	74-76
Paradise	Coles	RCG	13.1	4	24	5.0	15	-	75.9	77
Paris East	Edgar	RBL	30.4	10	42	10.3	27	$CuSO_4$	63.7	46
Paris West	Edgar	RBL	19.6	10	36	7.1	27	$CuSO_4$	70.0	64
WEST CENTRAL REGION										
Canton	Fulton	RDD	23.3	8	60	11.5	30	-	67.6	58
Glen Shoals	Montgomery	ROL	14.2	2	36	8.7	33	-	74.7	72
Gillespie Old	Macoupin	SOT	46.8	30	72	14.4	15	$CuSO_4$	57.5	26
Greenfield	Greene	RDZF	44.4	18	84	16.4	21	$CuSO_4$	58.3	34
Jacksonville	Morgan	RDO	28.0	24	36	6.9	3	-	64.9	47
LaHarpe	Hancock	RDZE	43.3	24	84	15.3	30	$CuSO_4$	58.6	36
Lou Yaeger	Montgomery	RON	9.6	4	20	3.6	36	-	80.3	81
Northern Oaks	Tazewell	SDW	41.2	22	66	13.3	18	$CuSO_4$	59.3	40
Petersburg	Menard	REL	66.5	24	120	20.9	59	Aquathol K/Diquat; $CuSO_4$	52.5	13
Pohlman	Calhoun	UDA	7.9	6	12	2.2	21	-	83.1	86
Royal	Calhoun	SDO	7.3	5	11	1.7	21	-	84.3	87
Spring	McDonough	RDR	17.5	2	48	12.1	33	$CuSO_4$	71.7	68
Springfield	Sangamon	REF	21.8	2	48	10.4	107	-	68.5	61-62
Staunton S.C.	Macoupin	RJP	45.0	24	96	20.5	14	$CuSO_4$	58.1	33
Swan	Calhoun	SDM	8.7	5	18	3.5	18	-	81.8	82
Taylorville	Christian	REC	8.6	1	19	4.1	36	-	81.9	83
Waverly	Morgan	SDC	10.8	2	24	5.6	36	$CuSO_4$	78.6	78
SOUTHERN REGION										
Altamont	Effingham	RCJ	41.6	18	96	22.7	27	$CuSO_4$	59.2	38
Ashley	Washington	RNZB	21.8	10	36	5.8	36	$CuSO_4$	68.5	61-62
Baldwin	St. Clair	ROW	27.8	22	30	3.5	27	-	65.0	48
Benton	Franklin	RNO	26.7	15	42	7.0	21	$CuSO_4$	65.6	50
Borah	Richland	RCB	81.8	42	156	31.7	24	-	49.5	8
Campus	Jackson	RNZH	46.0	24	102	21.7	37	-	57.8	28-29
Highland Silver	Madison	ROZA	13.8	2	25	4.9	65	-	75.1	73
Kinkaid	Jackson	RNC	51.3	2	150	29.3	184	-	56.2	21

TABLE 3. SUMMARY OF VOLUNTEER LAKE MONITORING PROGRAM RESULTS, ILLINOIS EPA, 1981 (CONTINUED).

LAKE	COUNTY	MAP CODE	SECCHI DISC TRANSPARENCY AVG.	MIN.	MAX.	DEV.	NO. OF OBSERVATIONS	LAKE MGMT	TROPHIC STATE INDEX	SECCHI RANK
Lake of Egypt	Johnson/ Williamson	RAL	45.7	30	65	11.4	12	-	57.9	30-31
Little Grassy	Williamson	RNK	87.4	60	126	17.8	28	-	48.5	5
Olney East Fork	Richland	RCC	87.0	54	108	18.9	6	-	48.6	6
Omaha	Gallatin	RAS	46.8	18	78	18.9	35	$CuSO_4$	57.5	26-27
Pinckneyville	Perry	RNH	38.2	13	60	13.7	39	-	60.4	42
Raccoon	Marion	ROK	13.6	4	30	6.8	21	$CuSO_4$	75.3	74-76
Salem	Marion	ROR	16.2	6	30	7.3	34	$CuSO_4$	72.8	70
Sara	Effingham	RCE	43.9	4	84	16.0	63	$CuSO_4$	58.4	35
Spring Arbor	Jackson	RNZG	106.6	81	120	8.4	21	-	45.8	2
Stanberry	Fayette	ROZE	10.0	10	10	0.0	3	-	79.7	80
Thompson F.C.	Jackson	RNZJ	26.4	12	78	16.3	33	TS PO_4 Fert.	65.7	52
Tower	Madison	RJO	45.1	36	54	4.8	18	$CuSO_4$	58.0	32
Vernor	Richland	RCA	70.0	30	120	27.6	24	$CuSO_4$	51.7	11
Vienna Corr.	Johnson	RAT	93.2	36	132	32.2	18	$CuSO_4$	47.6	4

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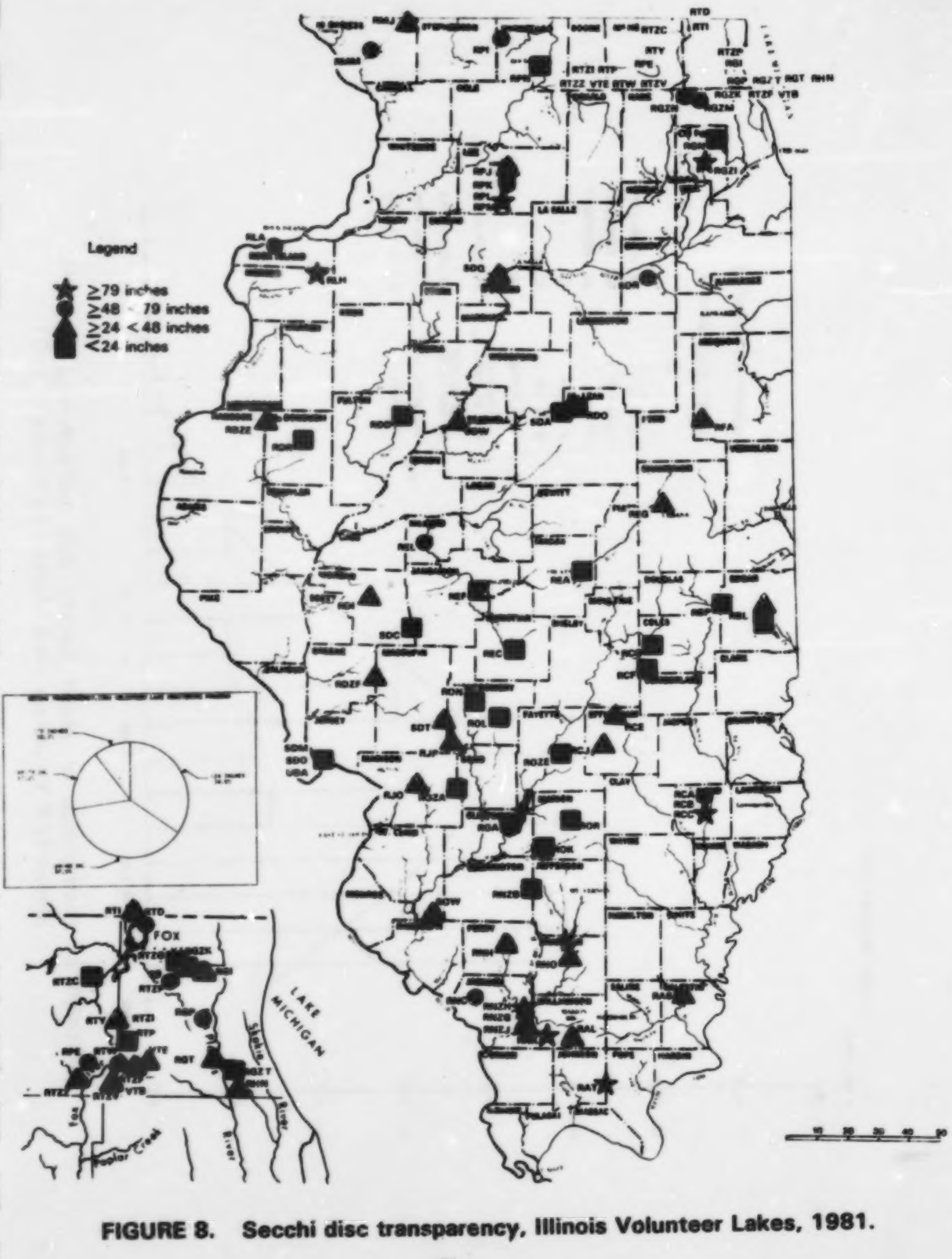
Legend
★ ≥79 inches
● ≥48 < 79 inches
▲ ≥24 < 48 inches
■ <24 inches
LAKE MICHIGAN
FOX
Poplar Creek

FIGURE 8. Secchi disc transparency, Illinois Volunteer Lakes, 1981.

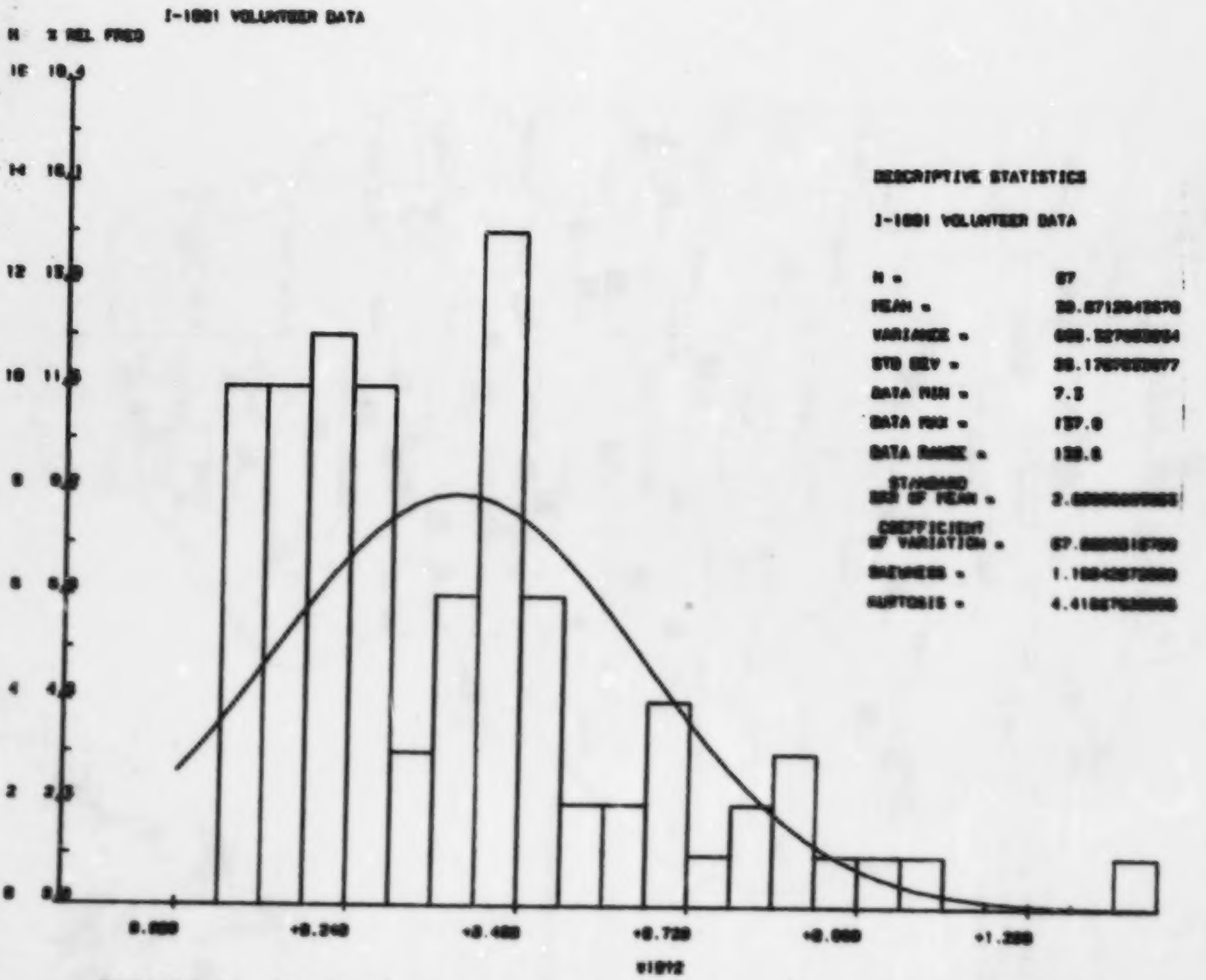

FIGURE 9. Distribution of mean Secchi disc transparency (inches), Illinois EPA Volunteer Lake Monitoring Program, 1981.

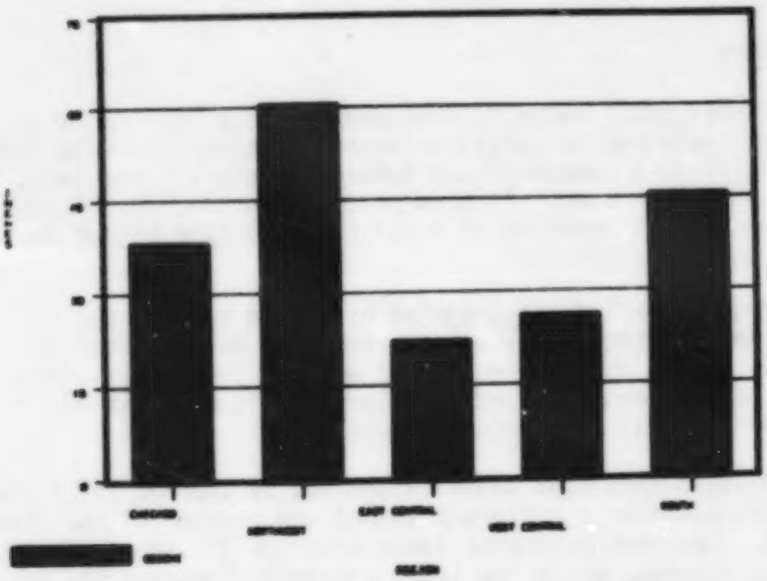

FIGURE 10. Mean Secchi disc transparency (inches) by region, Illinois EPA Volunteer Lake Monitoring Program, 1981.

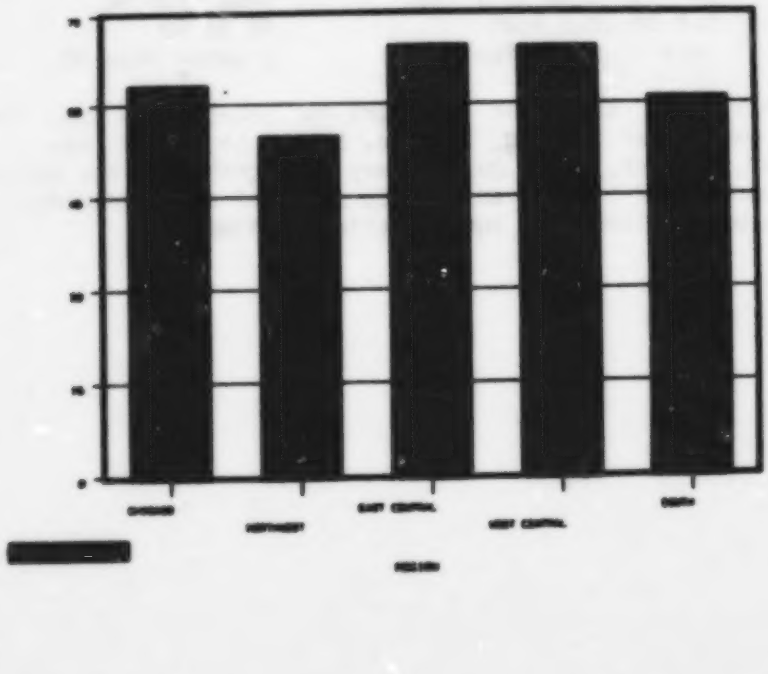

FIGURE 11. Mean Tropic State Index (Secchi) by region, Illinois EPA Volunteer Lake Monitoring Program, 1981.

Trophic State Index

A Trophic State Index (TSI) value is provided for each lake in Table 3. This parameter is explained in detail in report Section IV. Calculating a TSI (Carlson 1977) is a commonly used method for classifying lakes according to trophic condition. Each major division (10, 20, 30, etc.) of the index represents a doubling of algal biomass. The higher the TSI value, the more eutrophic the lake.

The average Trophic State Index aggregated by region is depicted in Figure 11. The least eutrophic lakes were found in northwestern and southern Illinois, while the most eutrophic were in central Illinois. The average TSI of the lakes sampled by volunteers in 1981 was 63; the minimum was 42 and the maximum 84 (see Figure 12).

The lakes were divided into four major categories by average TSI (SEC), with each category assigned a different symbol and plotted on the state map in Figure 13. The most eutrophic lakes (average TSI greater than 70) are designated by squares, while the least eutrophic (average TSI less than 50) are depicted by stars.

Using the classification of lakes by Secchi disc transparency (Allum, et al., 1977) and associated Trophic State Index (Carlson, 1977) presented below, none of the lakes monitored would be considered oligotrophic, nine would be considered mesotrophic, and the remainder eutrophic.

CLASSIFICATION	SECCHI DISC TRANSPARENCY	TROPHIC STATE INDEX
Oligotrophic	greater than 12.1 feet	less than 40
Mesotrophic	6.6 to 12.1 feet	40 to 50
Eutrophic	less than 6.6 feet	greater than 50

As discussed in Section IV, eutrophic lakes are not necessarily bad. In fact, in terms of warm water fishing, they may be the best. If they become too stressed, however, water quality may be degraded to the extent of producing nuisance algal blooms, an overabundance of aquatic weeds, deteriorating fish populations, and sedimentation problems.

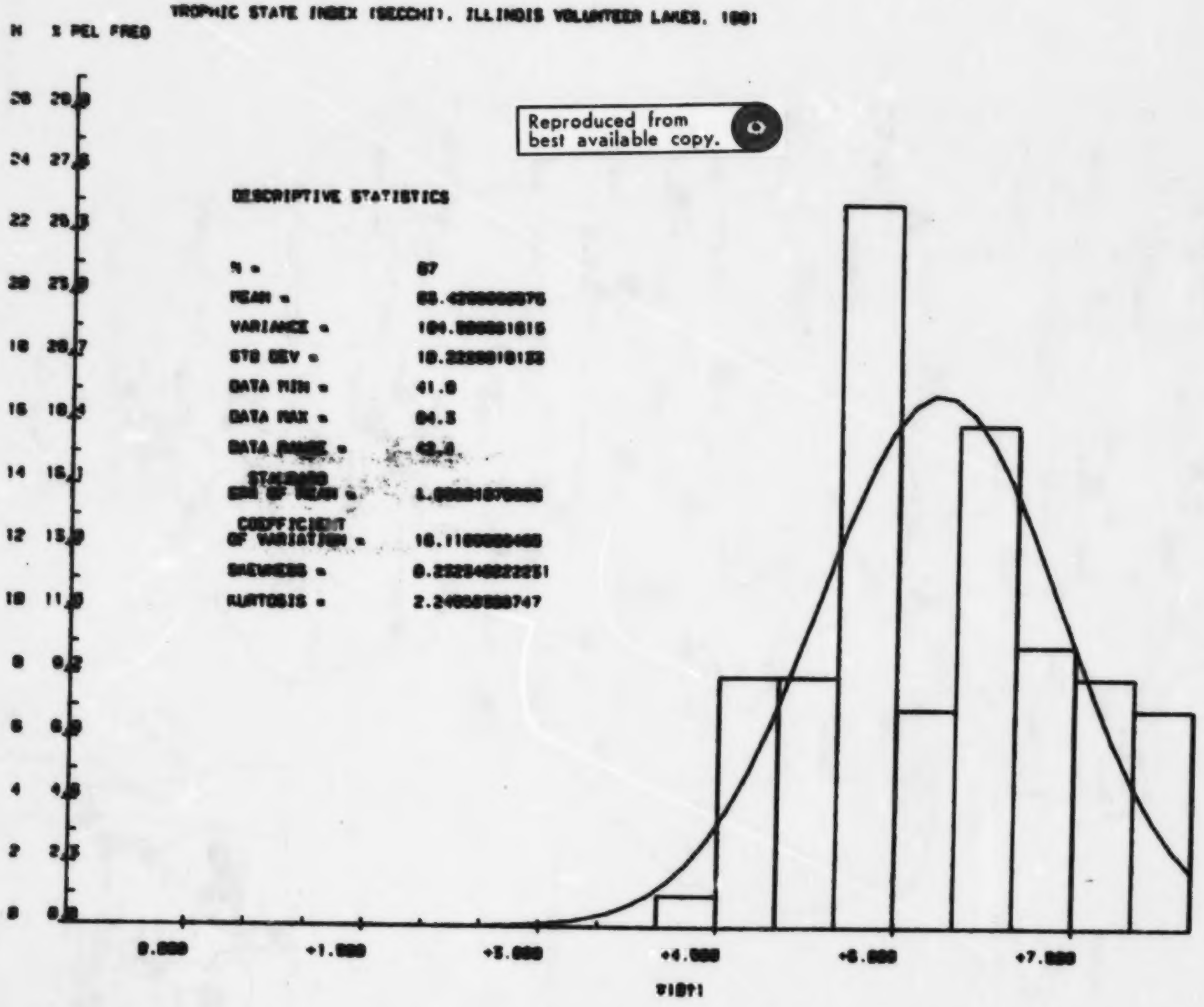

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FIGURE 12. Distribution of mean Trophic State Index (Secchi), Illinois EPA Volunteer Lake Monitoring Program, 1981.

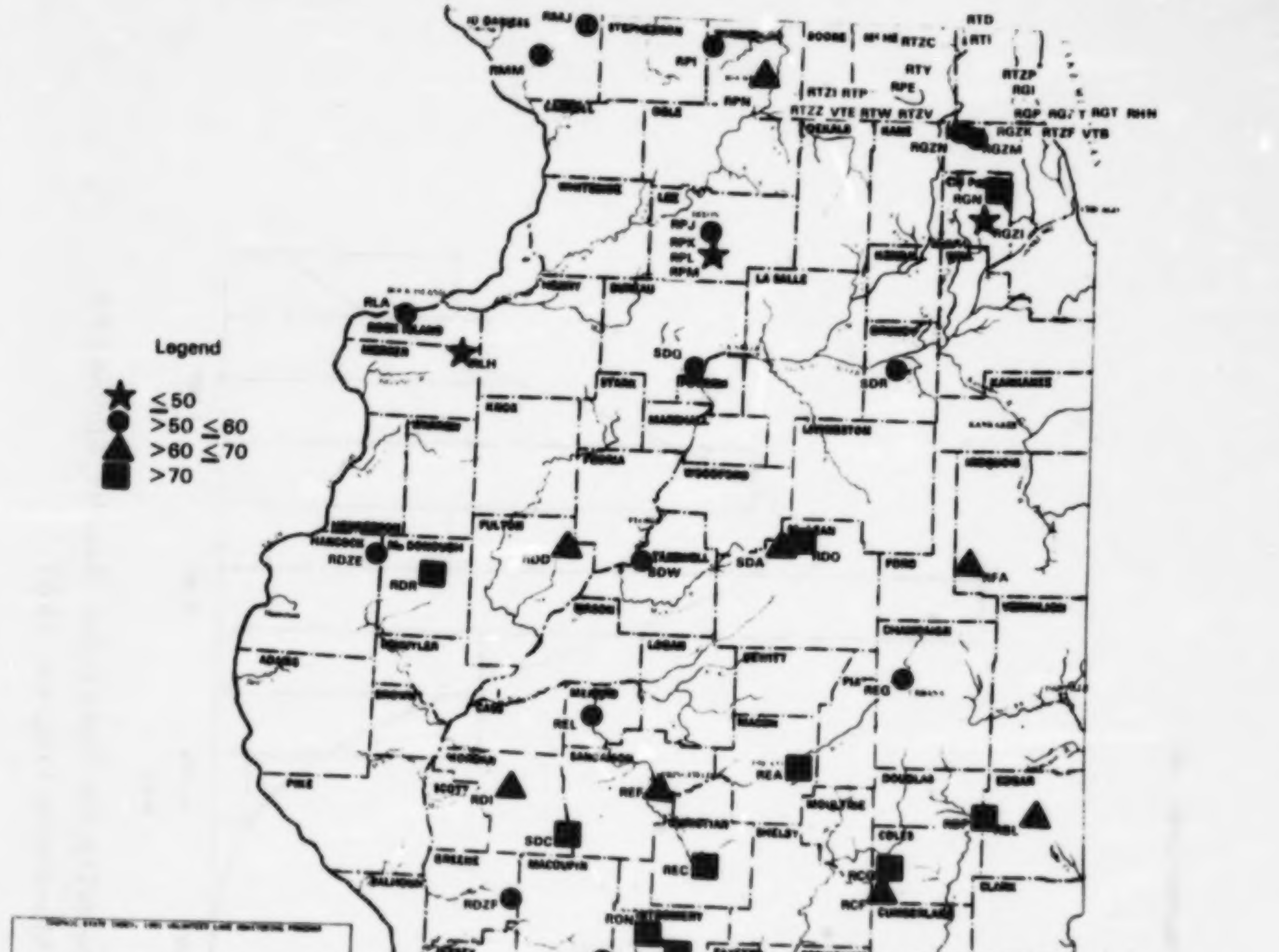

Legend
★ ≤50
● >50 ≤60
▲ >60 ≤70
■ >70
LAKE MICHIGAN
FOX
Des Plaines
Skokie River
Poplar Creek
RTD
RTI
RTZC
RTY
RPE
RTZP
RGI
RTZI
RTP
RTZZ
VTE
RTW
RTZV
RGP
RGT
RGZT
RHH
RTZF
VTB
RGZK
RGZN
RGZM
RGN
RGZI
RMM
RMJ
RPI
RPN
RPJ
RPK
RPL
RPM
RLA
RLH
SDQ
SDR
RDZE
RDR
RDD
SDW
SDA
RDO
RFA
REG
REL
REA
RDI
REF
SDC
REC
RCD
RCF
RDZF
RON
ROL
SDT
RJP
SDM
SDO
UDA
RJO
ROZA
RCE
RCJ
ROZE
RCA
RCB
RCC
ROA
ROR
ROK
ROW
RNZH
RNZG
RAL
RAT
10 20 30 40 50

FIGURE 13. Trophic State Index (Secchi), Illinois Volunteer Lakes, 1981.

SECTION IV. UNDERSTANDING ILLINOIS LAKES

INTRODUCTION

The study of the physical, chemical and biological aspects of freshwater lakes is called limnology. It is a very broad and complex science, but one which is necessary for the proper understanding and management of the resource. The scientists who study lakes are called limnologists.

This section is intended to give individuals concerned about the protection and management of Illinois lakes some basic information on lake ecology, problems, causes, and protection/management techniques. It is not intended to serve as a complete reference manual, but to expose the reader to some of the basic issues and problems which should be considered.

The paper is written in nontechnical language in an attempt to bridge the information gap between the technical expert and the citizen who must be responsible for initiating the necessary action to preserve what is good and to correct problems that exist in a lake. Terms which the reader may not be familiar with are underlined and briefly defined where first used in the text, and are more fully defined in the glossary. This report incorporates much material from Dion (1978), Fulton, et. al (1971), section Water Resources Center (1981) and Sefton (1978).

LAKE ORIGINS

Natural Lakes

Glacial Lakes

Approximately two percent of the 2900 lakes (six acres or larger) in Illinois are of glacial origin; these natural glacial lakes are restricted to extreme northeastern Illinois (Cook, Lake and McHenry Counties).

Most of these glacial lakes were formed in depressions left by melting ice blocks. As the ice sheets slowly disintegrated into separate blocks, some of them were buried in the glacial till. When these blocks melted, numerous depressions were formed. Lakes now exist in the depressions wherever the level of the water table is high enough. Some, like the Great Lakes, are the result of glacial "scouring": the glaciers wore away the bedrock and deepened valleys as they moved southward, forming deep depressions which eventually filled with water.

Oxbows and River Backwaters

Oxbow lakes are formed when meandering streams cut a new and straighter channel, by-passing the old streambed. Natural bottomland, backwater, and oxbow lakes are found along the state's major rivers, especially the Illinois and Mississippi. They comprise about 23 percent of the lakes in the state.

Artificially Constructed Lakes

Approximately 75 percent of the lakes in Illinois are artificial, formed by placing a dam on a river or by excavating a depression which subsequently fills with water. Artificial lakes are usually constructed for specific water use objectives, such as storage for municipal, industrial, and agricultural water supplies, power generation, navigation, irrigation, flood control, recreation, residential development, stormwater retention, and fish and wildlife management. Some, such as borrow pits, strip mine lakes, and gravel pits, are a by-product of human activities.

Artificial lakes (reservoirs) created by damming rivers and backing up water in the river valleys are usually long and narrow, rather than circular. The shorelines tend to be very long and irregular, because they conform to the terrain of the river valley.

Artificially constructed lakes often fill up with silt much faster than natural lakes. If the river which is dammed up to create the lake has a great deal of eroded soil suspended in it, this heavier silt will settle out and drop to the bottom of the lake when the speed and tumbling action of the river flow decreases in the lake.

Typically, Illinois reservoirs exhibit significant spatial (within lake) differences in water quality from the lake headwaters (upper end, where tributaries enter) to the dam (lower end). Three or more sites are usually monitored on Illinois lakes in order to take into account these spatial differences in quality.

A large sediment and nutrient load is often carried into the reservoirs by inflowing streams. The sediment turns the water brown and the nutrients act like lawn fertilizer to promote the growth of aquatic weeds and algae, which turn it green or greenish-brown; both lessen the water clarity. The water clarity of the upper end is also often decreased due to the shallow nature of the headwaters area, which allows wind and wave action to resuspend the bottom sediment.

If the lake is large enough and has a long enough water retention time, the sediment tends to settle out in the lake headwaters and the water becomes clearer (has a greater Secchi transparency) toward the dam. As the sediment settles out, algae populations often become more apparent and turn the water more green or greenish-brown nearer the dam.

LAKE SHAPE

Lake shape is best portrayed by a detailed bathymetric (depth) map such as the one shown in Figure 14. These maps are usually made by combining land surveying or aerial photography for the shore outline, with depth soundings made from a boat.

The measurement of the shape of geographic features of the earth is termed morphometry. From the bathymetric map can be obtained a number of morphometric parameters which express certain aspects of the lake shape in numerical terms and which allow quantitative comparisons between lakes.

The area of a lake is the size of its surface as determined on a map or aerial photograph of known scale. The storage capacity or volume of a lake is usually reported in acre-feet -- the amount of water required to cover one acre to a depth of one foot -- or in million gallons.

The maximum depth of a lake is the greatest depth sounded; sedimentation, erosion, and lake-stage fluctuations, however, can rapidly alter the depth of a lake. The mean depth or average depth (in feet) of a lake is obtained by dividing lake volume (in acre-ft) by lake area (in acres). Most Illinois lakes (about 75%) are shallow, with mean depths of less than 15 feet.

LAKE HYDROLOGY

The water supply of a lake is governed by the hydrologic cycle, the system in which water evaporates into the atmosphere from the earth's surface and then condenses to return to earth as precipitation to replenish the surface and underground supplies of water. The cycle, portrayed in Fig. 15, is driven chiefly by solar energy and gravity.

One of the hydrologic variables sometimes used in comparing lakes is the water retention time or water renewal time. It is the time needed to replace the entire volume of a lake under average conditions of inflow and outflow. It is shorter for shallow lakes with large watersheds and longer for deep lakes with small watersheds.

The nature of the watershed or drainage area determines the amount and purity of the water reaching the lake. The types of soil, rocks, vegetation, topography, and residential or industrial development in the watershed all have an effect on the quality and quantity of surface and sub-surface drainage.

The lake serves as a trap for sediment, organic materials, and nutrients generated in its drainage basin. Once in the lake, much of the material deposited is reused or recycled, whereas the constant flow of water in a river may flush out pollution fairly rapidly.

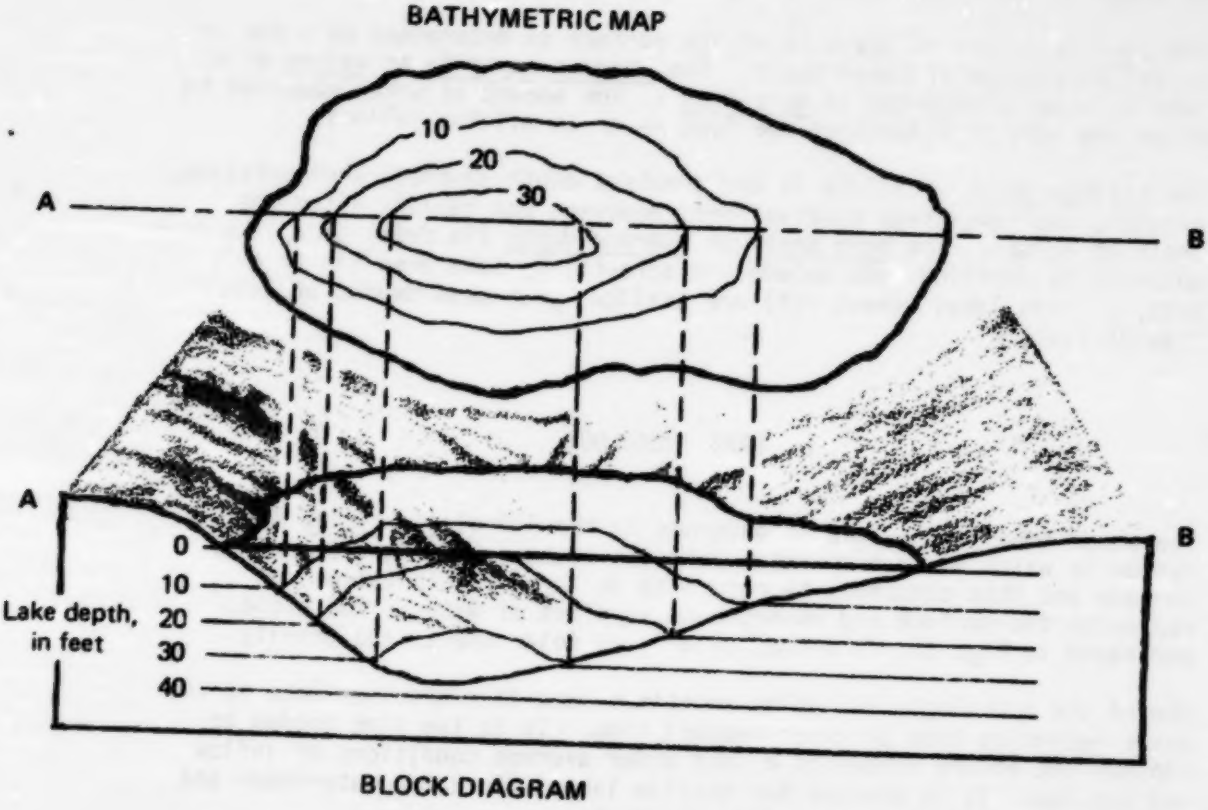

BATHYMETRIC MAP
10
20
30
A
B
A
B
0
10
20
30
40
Lake depth, in feet
BLOCK DIAGRAM

FIGURE 14. A bathymetric map and the lake it represents (from Dion, 1978).

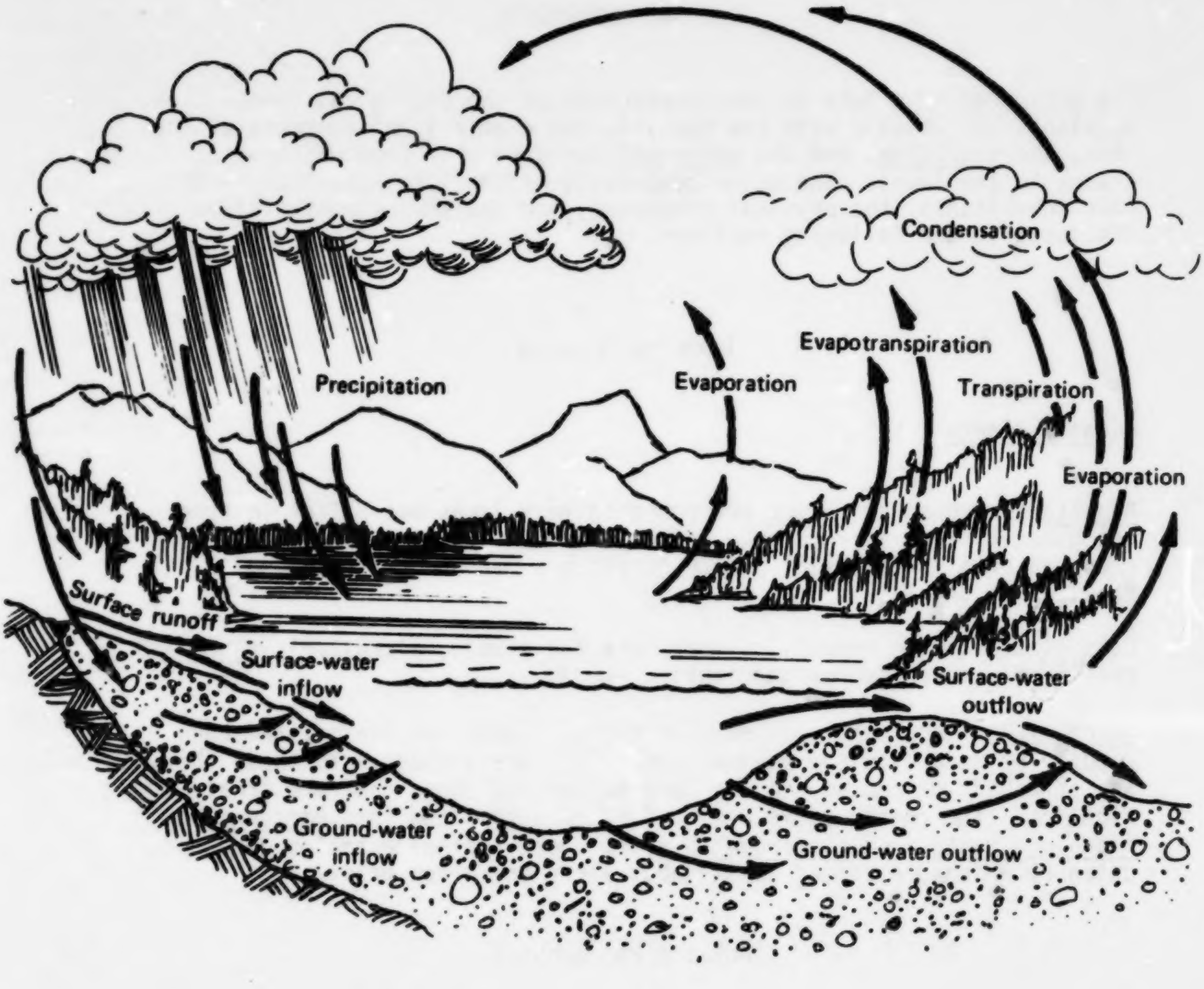

Condensation
Precipitation
Evapotranspiration
Evaporation
Transpiration
Evaporation
Surface runoff
Surface-water inflow
Surface-water outflow
Ground-water inflow
Ground-water outflow

FIGURE 15. The hydrologic cycle (from Dion, 1978).

When a lake becomes polluted, it may take many years for it to "recover", or return to something near its original ecological balance, even if the sources of pollution are discovered and eliminated immediately.

THE LAKE ECOSYSTEM

The ecosystem of a lake is the interaction of the biological communities of plants and animals with the physical and chemical environments of the lake, the shoreline, and the watershed (or land area from which water drains to the lake). The major components of the lake ecosystem -- the lake inhabitants, the physical processes, and the environment will be discussed in the following sections.

Lake Inhabitants

Aquatic Plants

Aquatic (freshwater) plants are found in most lakes but differ in type and quantity from lake to lake and with time. The composition and richness of a lake's plant growth is often a measure of the overall "health" of the lake.

Lake plants can be broadly divided into the simple, microscopic algae and the larger, more complex macrophytes (weeds).

Macrophytes. Most macrophytes have roots, stems, and leaves, and can readily be seen with the unaided eye. They are divided into those that are attached, or rooted, to the lake bottom and those that are freely floating. The rooted forms can be further subdivided into emergent, floating-leaved, and submergent plants. Some typical examples of each category which are common in Illinois lakes are given below.

Aquatic Macrophytes

Manner of Growth	Representative Plants
Rooted	--
Emergent (above water)	Bulrush, cattail, sedge
Floating-leaved (leaves floating on surface)	Watershield, waterlilies, some pondweed
Submergent (underwater)	Elodea, coontail, watermilfoil, most pondweed
Freely floating	Duckweed

Rooted plants are usually found attached in shallow areas where sunlight reaches the lake bottom. These plants provide bases of attachment for some forms of algae, provide shelter and protection for insects, birds, and fish, and contribute, as do all aquatic plants, to the oxygen supply of the lake. In addition, rooted plants draw nutrients from the soil; upon the death and decay of the plants the nutrients become available to nourish algae.

Rooted plants may limit recreational usage of a lake if excessive growths occur. Dense growths may also affect fish populations by restricting the ability of game species to catch smaller forage fish, resulting in unbalanced fish populations and lower yield of desirable sizes and types. Decomposition of large amounts of aquatic vegetation can cause heavy oxygen demands resulting in fishkills. Plants may also accumulate on the bottom to reduce water depth.

Algae. Algae contain the pigment chlorophyll, which imparts a green color to the water, but lack the roots, stems, and leaves characteristic of macrophytes. Most algae are planktonic -- that is, they float passively in the water and are called phytoplankton. Others are attached to submerged rocks, wood, concrete, and even larger plants. A few algae common to Illinois lakes are shown in Figure 16.

Most individual algal cells are microscopic (invisible without magnification), but they may form colonies or clumps that are visible. These colonies may be filaments, balls, mats, or even "grass clippings" in the water. Even if algae can't be seen by the naked eye, their presence can be determined because they impart a green, greenish-brown, yellowish, or blue-green color to the water.

Algae occur in various shapes, sizes, and ecological roles. The most commonly encountered groups of algae in Illinois lakes are the greens, blue-greens, and diatoms.

Green algae contain bright, grass-green pigments and have a well-defined nucleus. The cells of green algae may occur singly, as spherical colonies, or as filaments. Green algae are generally most abundant in spring and fall, although they are found throughout the year. They usually do not affect transparency as much as the blue-greens.

Blue-green algae lack the well-defined nucleus found in green algae and, in addition to green chlorophyll, contain blue, and often red, pigments. Most blue-green algae are filamentous and all occur in gelatinous sheaths. Blue-green algae are the most apt to produce the offensive algal blooms (population explosions of algae) frequently seen on the surface of water bodies. When they become overabundant, blue-green algae may give water an unpleasant odor or taste, and some, through the release

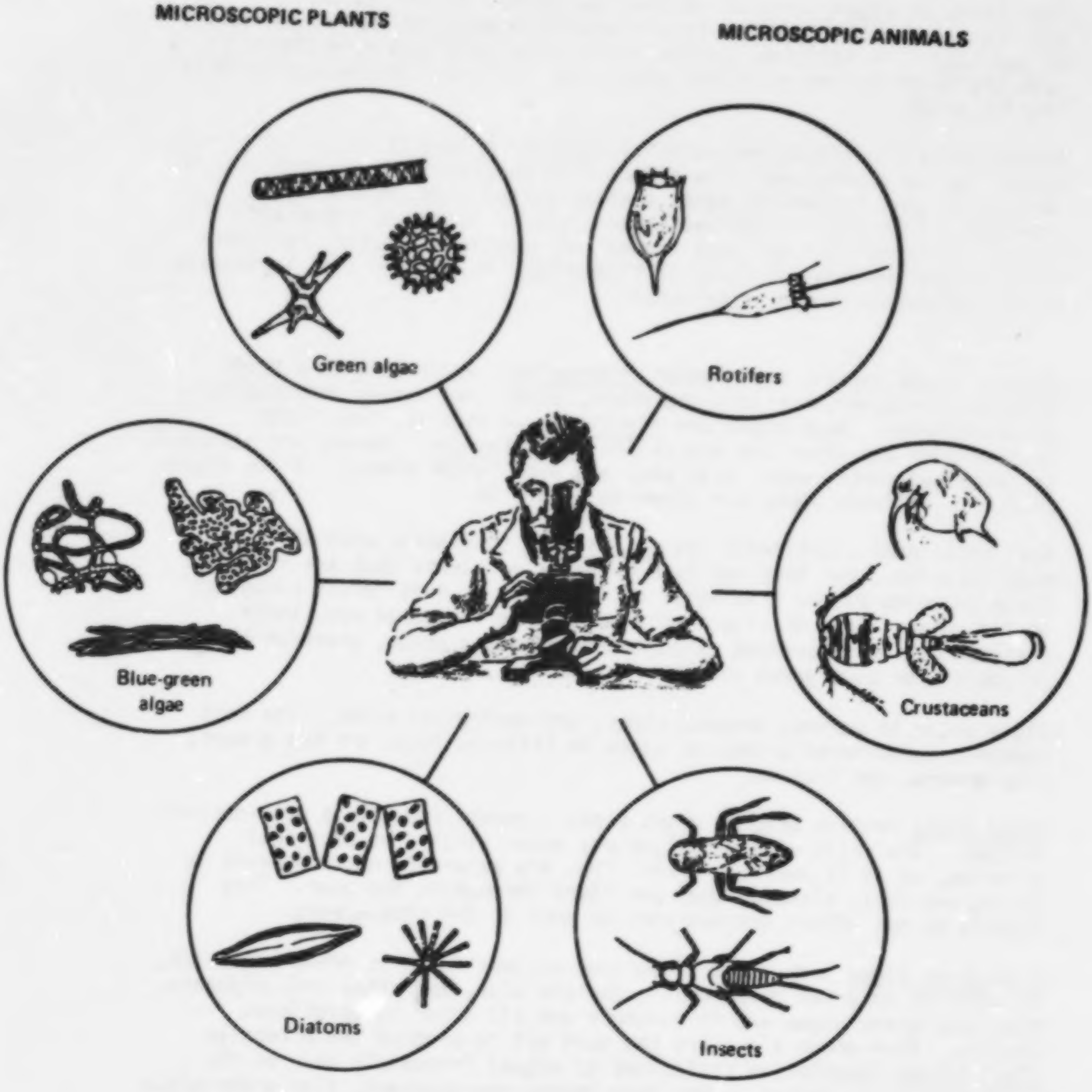

MICROSCOPIC PLANTS
MICROSCOPIC ANIMALS
Green algae
Rotifers
Blue-green algae
Crustaceans
Diatoms
Insects

FIGURE 16. Microscopic plants and animals typical of Illinois lakes (from Dion, 1978).

of toxins, make the water poisonous to the animals that drink it. In addition, the gelatinous sheaths of blue-green algae make them difficult to filter in water-treatment operations. Blue-green algae are usually most abundant during warm weather periods in the summer and can greatly reduce the water transparency.

Diatoms are yellow-geen or yellow-brown algae that occur singly or, more rarely, in colonies. Their cells, the walls of which are made of hard silica, are composed of two overlapping halves, similar to a pillbox. They are the most common forms in stream-like environments and in reservoirs with short retention times. They are generally most abundant during cooler weather periods in the spring and fall.

Aquatic Animals

The aquatic animals commonly seen in Illinois lakes range in size from microscopic, invertebrate (without backbone) animals to the larger, vertebrate (with backbone) animals such as fish.

Vertebrates. The aquatic vertebrates commonly seen in or near lakes are fishes, amphibians (e.g., frogs), reptiles (e.g., snakes, turtles), birds, and mammals (e.g., otter, beaver). Because of their larger size, they are easily spotted and generally of more interest to people than are the smaller animals without backbones. Numerically, however, the vertebrates are a relatively small part of a lake's animal population.

Invertebrates. The most common and numerous animals in Illinois lakes are the invertebrate rotifers, crustaceans, and insects, a few of which are shown in Figure 16. Although they are usually present in large numbers, they are seldom noticed because of their small size. The smaller invertebrates that drift passively with the water currents are known collectively as zooplankton (the animal part of the plankton). Unlike the phytoplankton, however, many of the zooplankton are capable of limited locomotion. Zooplankton are important food sources for larger invertebrates and fish.

Literally thousands of species of insects spend part, or all, of their lives in fresh water. Many that spend their adult life out of water, such as mayflies and dragonflies, have immature stages -- nymphs, larvae and pupae -- that develop beneath the water in the bottom sediments. These macroinvertebrates are called benthos (bottom dwelling organisms). All insects, especially in their immature stages, are important sources of food for vertebrates.

Inputs

The most important natural ingredients which enter the lake ecosystem are energy (mainly sunlight); oxygen, carbon dioxide and nitrogen (mainly from the atmosphere); water; and other materials, such as eroding soil and nutrients (primarily nitrogen and phosphorus) carried into the lake by running water, wind, or waves. Activities of man, such as farming, boating, housing development, fertilization, and use of pesticides can change drastically the amounts and types of these inputs and thus change the ecosystem. Since light, carbon dioxide, and water are usually available anyway, the limits to the growth of algae and other plants are most often determined by nutrients (particularly phosphorus and nitrogen) and traces of other chemicals.

Photosynthesis and Respiration

Energy from the sun is the driving force in this natural system. Green plants (weeds and algae) use this energy to transform water, carbon dioxide and other materials into living plant cells and into organic matter (fats, sugars and proteins) needed to maintain life. This process is called photosynthesis. Green plants are called producers because only they can make food by this process. The oxygen in the air we breathe as well as in the water is a by-product of photosynthesis. If there were no green plants eventually there would be no available oxygen to support life.

In order to stay alive, algae and other green plants use some of the food they produce even before it can be passed on to animals. This process, called respiration, consumes oxygen and results in carbon dioxide and water again, the original starting materials.

The region of the lake where enough sunlight penetrates to allow photosynthetic production of oxygen is the euphotic (lighted) zone. (Usually for Illinois lakes, it is between two and five times the Secchi disc transparency.)

A Secchi disc is an eight inch diameter metal plate painted black and white in alternating quadrants, which is used to measure the transparency or clarity of the water. It's use is depicted in Figure 17. The depth at which the disc disappears from view is termed the Secchi disc transparency.

The lower limit of the euphotic zone is termed the compensation level. This is where photosynthesis equals respiration. The depth of the compensation level (volume of the euphotic zone) varies with time of day and season of the year as does the Secchi disc transparency. Algae, zooplankton, water color, and especially sediment (silt, clay, and organic matter) are factors which interfere with light penetration, increase the turbidity of the water, and lessen the Secchi disc transparency.

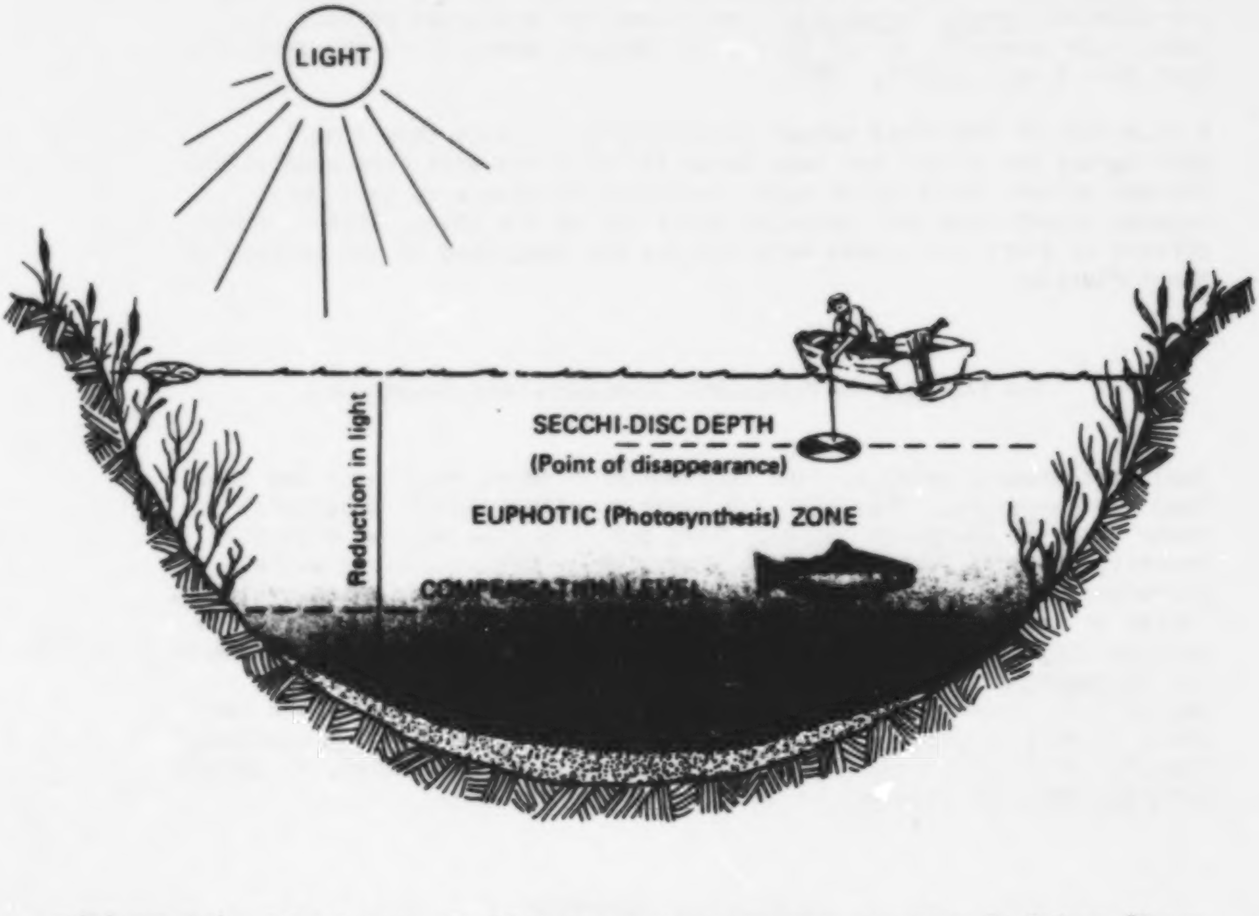

LIGHT
SECCHI-DISC DEPTH
(Point of disappearance)
Reduction in light
EUPHOTIC (Photosynthesis) ZONE
COMPENSATION LEVEL

FIGURE 17. **Light zones and transparency measurements in lakes (from Dion, 1978).**

Below the euphotic zone is the aphotic (without light) zone where there is not enough light to maintain photosynthesis. Respiration exceeds photosynthesis and dissolved oxygen deficiencies are likely to occur in this region of the lake.

In the aphotic zone, or at night or on cloudy days, when oxygen is not being produced by photosynthesis of aquatic weeds and algae, all the oxygen in the water may be used up by respiration of plants, animals, bacteria, and fungi. When the oxygen in a lake decreases sharply, or if it is used up entirely, the lake environment changes drastically. Many fish kills can be traced to oxygen deficiencies. Only a few organisms can tolerate anoxic (anaerobic) conditions for prolonged periods, and sport fish generally do not thrive in habitats where dissolved oxygen is less than 5 mg/l (USEPA, 1980).

A reduction of dissolved oxygen concentration to less than 3 mg/l (milligrams per liter) has been shown to interfere with fish populations through delayed hatching of eggs, decreased tolerance to toxicants, reduced growth rate and increased mortality of fry (Dion, 1978). Other effects of dissolved oxygen deficiencies are described in the section on stratification.

The Food Web -- Producers, Consumers and Decomposers

Small microscopic animals, like zooplankton, cannot make their own food. They are consumers. They must eat algae or other plants (producers) as their food, or source of energy. This process, like our own digestive process, produces carbon dioxide, water, waste heat and other waste products. These small animals living in the water may be eaten by insect larvae or small fish. The small fish and insect larvae may be eaten in turn by bigger fish or bigger insect larvae. As producers and consumers do, decomposers -- chiefly bacteria and fungi -- break down organic matter into elements such as carbon, hydrogen, and nitrogen, which can again be used as building blocks to build organic matter. The continuous transfer of food energy, with repeated eating and being eaten, is called the food chain or food web (illustrated in Figure 18).

A Balanced Community

The producers, consumers, and decomposers within a lake ecosystem are usually in healthy balance, but only remain so under suitable water quality conditions. This balance can be disrupted by the input of excessive amounts of organic (sewage, fertilizer) and inorganic materials (sediment, nutrients) as a result of natural or human activities. The lake ecosystem is capable of adjusting for such events, but the change often leads to lake conditions that are adverse to the public's use and enjoyment of the water. Periodic evaluations of the ecosystems of Illinois lakes are important to ascertain the general health of the lakes and to determine if any adverse lake conditions have occurred.

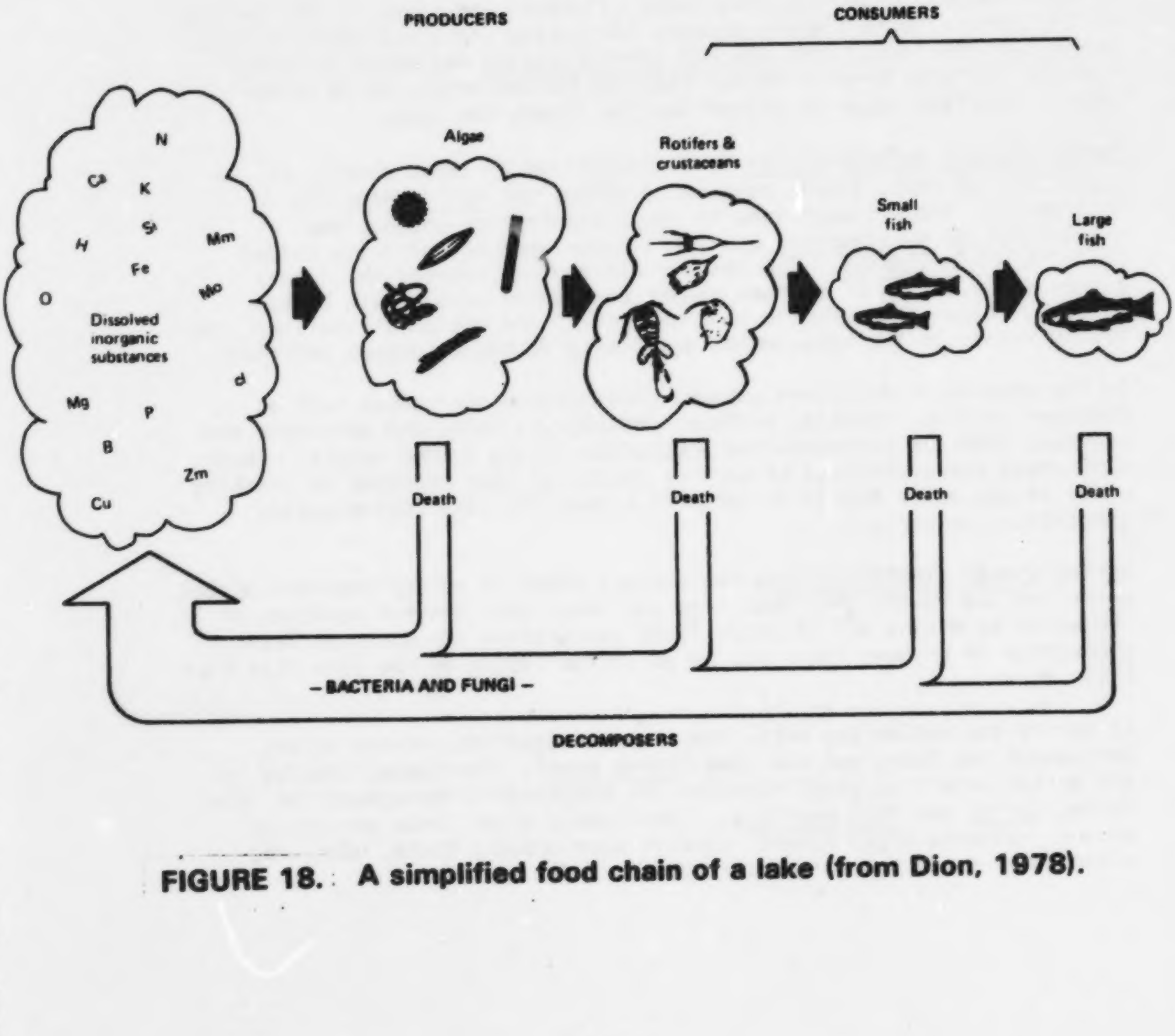

PRODUCERS
CONSUMERS
N
Ca
K
Si
H
Mm
Fe
Mo
O
Dissolved inorganic substances
Cl
Mg
P
B
Zm
Cu
Algae
Rotifers & crustaceans
Small fish
Large fish
Death
Death
Death
Death
– BACTERIA AND FUNGI –
DECOMPOSERS

FIGURE 18. A simplified food chain of a lake (from Dion, 1978).

THERMAL STRATIFICATION

In many lakes (particularly those with maximum depths greater than 10 feet), there are considerable seasonal variations in the amounts of dissolved oxygen and nutrients in various parts of the lake (illustrated in Figure 19). These variations, which can cause taste and odor problems, sudden algae blooms, increased weed growths, or fish kills, are due in part to the physical properties of the water itself: the relationship of the density of water to its temperature.

As water warms, it becomes less dense (lighter) and rises to the surface of the lake. Thermal layers appear, inhibiting the circulation of water throughout the lake. This thermal stratification may occur in summer, when the surface water is warmer than the bottom water, or in winter, when the surface water is colder and ice covers the lake.

Summer thermal stratification is characterized by three zones: (1) an upper zone of warm, mixed, oxygenated water, the epilimnion; (2) an intermediate transitional zone of rapid temperature change, the thermocline or metalimnion; and (3) a lower zone of uniformly colder water, the hypolimnion. The density differences between the layers prevents the mixing of surface waters containing oxygen with bottom waters. Unless the euphotic zone extends to the bottom of the lake, the bottom waters in the hypolimnion are likely to become oxygen deficient.

In the absence of dissolved oxygen, undesireable substances such as hydrogen sulfide, ammonia, methane, phosphorus, iron, and manganese are released from the sediments and accumulate in the bottom waters. These substances can contribute to serious taste and odor problems in drinking water if the water supply is taken from near the lake bottom during stratification periods.

During winter stratification, the surface water is colder than the bottom water and ice covers the lake. Ice and snow cover prevent aeration of the water by mixing and decrease light penetration for photosynthetic production of oxygen; there may be so little oxygen in the lake that fish kills occur.

In spring and autumn the water temperatures equalize, mixing occurs throughout the lake, and the lake "turns over". Substances trapped in the bottom waters by stratification are distributed throughout the lake during spring and fall overturn. Immediately after these periods of mixing, nuisance algal blooms, aquatic weed growth, taste, odor, and other water quality problems are common.

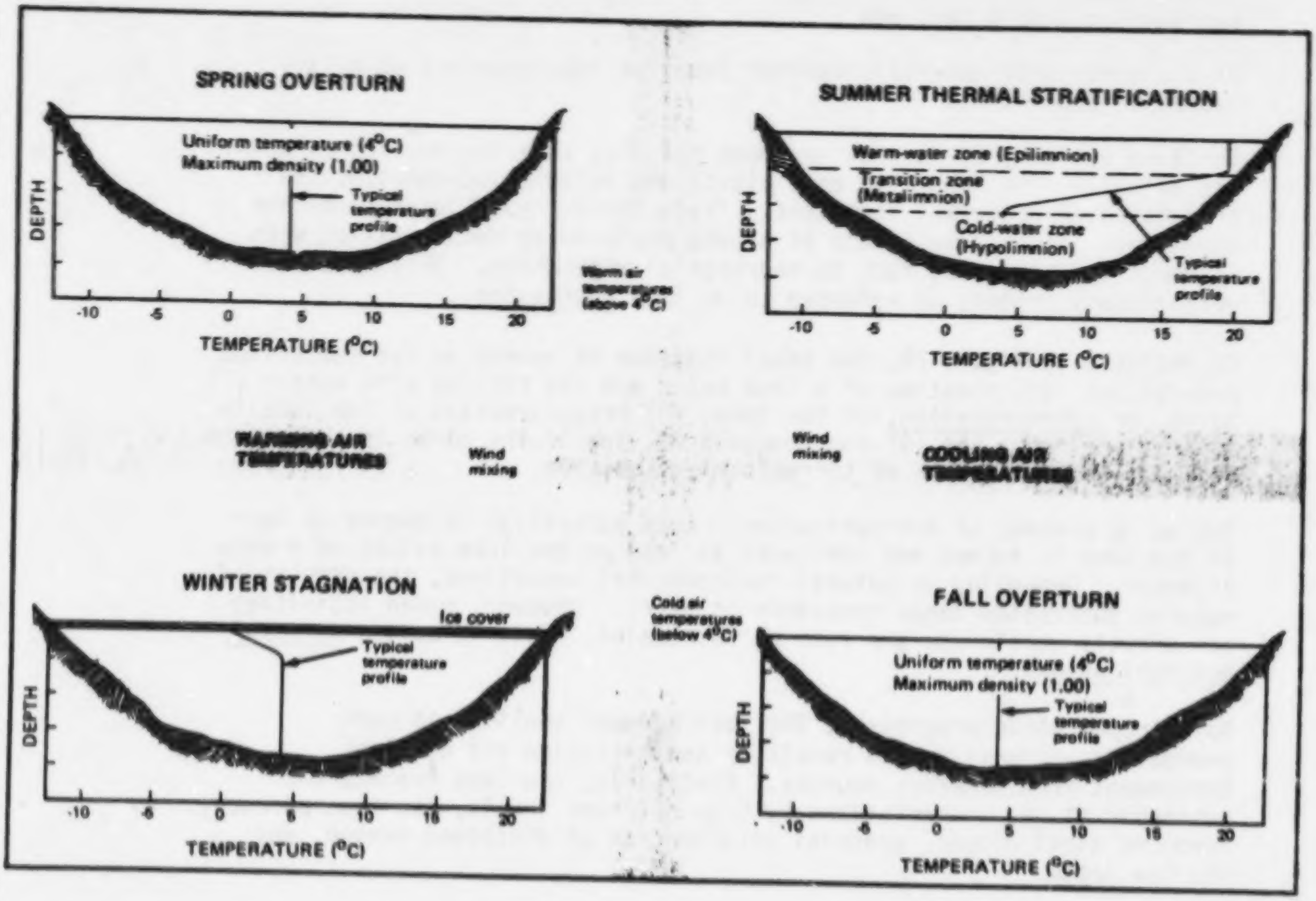

SPRING OVERTURN
Uniform temperature (4°C)
Maximum density (1.00)
Typical temperature profile
DEPTH
-10
-5
0
5
10
15
20
TEMPERATURE (°C)
Warm air temperatures (above 4°C)
SUMMER THERMAL STRATIFICATION
Warm-water zone (Epilimnion)
Transition zone (Metalimnion)
Cold-water zone (Hypolimnion)
Typical temperature profile
DEPTH
-10
-5
0
5
10
15
20
TEMPERATURE (°C)
WARMING AIR TEMPERATURES
Wind mixing
Wind mixing
COOLING AIR TEMPERATURES
WINTER STAGNATION
Ice cover
Typical temperature profile
DEPTH
-10
-5
0
5
10
15
20
TEMPERATURE (°C)
Cold air temperatures (below 4°C)
FALL OVERTURN
Uniform temperature (4°C)
Maximum density (1.00)
Typical temperature profile
DEPTH
-10
-5
0
5
10
15
20
TEMPERATURE (°C)

FIGURE 19. The annual temperature cycle of a temperate region lake (from Dion, 1978).

LAKE SUCCESSION AND EUTROPHICATION

Although lakes tend to be in a balance or equilibrium, two types of natural long-term changes are occurring:

1) The lake is gradually filling with eroding soil from upstream and surrounding land areas; and

2) the additional materials carried into the lake area may stimulate increased production.

The lake not only fills with sediment but also with the remains of plants and animals. The number of dead plants and animals increases as the production of organisms increases. These forces cause lakes to become shallower. The ultimate fate of a lake basin is to become filled with sediment and to revert back to terrestrial vegetation. This natural evolutionary process is referred to as lake succession.

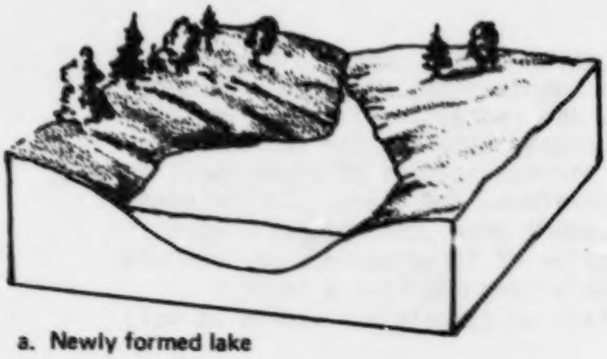
As depicted in Figure 20, the usual sequence of events in the succession process is: (1) creation of a lake basin and its filling with water; (2) aging, or eutrophication, of the lake; (3) transformation of the lake to a marsh or swamp; and (4) the complete filling of the marsh or swamp with sediment and the growth of terrestrial vegetation.

The aging process of eutrophication occurs naturally; it begins as soon as the lake is formed and continues as long as the lake exists as a body of water. Depending on natural environmental conditions, the process of natural succession takes thousands of years. However, human activities can greatly accelerate the rate of succession. This is called cultural eutrophication.

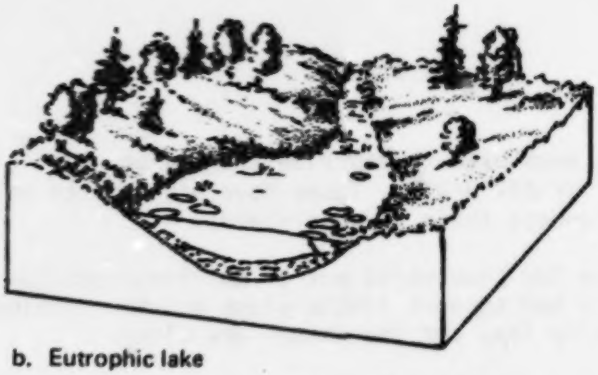
As eutrophication progresses, the lake becomes smaller and more productive, primarily as a result of sedimentation and nutrient enrichment from numerous sources. Eventually, the lake reaches the eutrophic stage, characterized by high nutrient levels, low transparency, frequent algal blooms, seasonal deficiencies of dissolved oxygen, and shallow depth.

In addition to increases in the numbers of plants and animals, the types of organisms may also change as eutrophication progresses. For instance, green algae and diatoms may be replaced by the more troublesome blue-green algae, and game fish such as bass and northern pike may be replaced by carp and catfish.

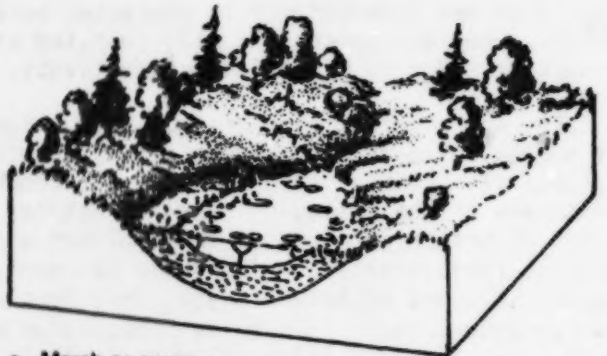
Sedimentation is a major cause of lake succession and eutrophication in Illinois. Most sediments are brought into a lake by tributary streams, storm runoff, and wind, but some originate within the lake from decaying vegetation and from shoreline erosion. Sedimentation may increase the productivity of a lake because plant nutrients are usually attached to the incoming sediments and the newly deposited sediments provide additional rooting areas for aquatic plants.



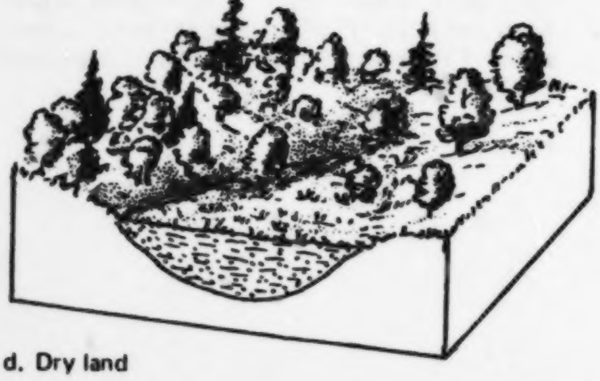
a. Newly formed lake



b. Eutrophic lake



c. Marsh or swamp



d. Dry land

FIGURE 20. The natural succession of a lake (from Dion, 1978).

The usual effects of cultural eutrophication are to impair the quality of the water and to increase the costs and complexities of water treatment for domestic, industrial, agricultural, and recreational uses. One of the more troublesome aspects of lake eutrophication is the increased frequency of taste and odor problems. Various species of algae smell or taste like fish, pigpens, cucumbers, geraniums, and grass. In the deep zone of a eutrophic lake, where algae cannot grow, the reduced oxygen concentration often causes the accumulation of large amounts of iron and manganese. Water supplies taken from this zone may have a "rusty" appearance and cause a reddish-brown stain on porcelain fixtures as well as have taste and odor problems.

Trophic State

The term trophic state has been used to describe the degree of eutrophication of a lake. Traditionally, lakes have been placed into three broad categories to denote their trophic status.

1. Oligotrophic lakes have low concentrations of nutrients such as phosphorus and nitrogen and support little plant growth. Biological productivity is generally low, and the waters are clear.

2. Mesotrophic lakes are intermediate in character between oligotrophic and eutrophic. They are moderately well supplied with nutrients and generally support moderate biological productivity.

3. Eutrophic lakes are nutrient rich and generally highly productive, capable of supporting a large amount of plant growth and other biological activity. USEPA (1980) defines a eutrophic lake as one that exhibits any of the following characteristics: biomass accumulations of primary producers (algal blooms and excessive aquatic weeds); rapid organic or inorganic sedimentation and shallowing; or seasonal dissolved oxygen deficiencies in the bottom waters and subsequent shift in species composition of aquatic organisms to forms that can tolerate lower concentrations of oxygen. Eutrophic lakes cover a myriad of water quality conditions, ranging from very desirable recreational lakes that support excellent warm water fisheries to lakes with undesirable aesthetics and water use limitations.

The Trophic State Index (TSI) of Carlson (1977) is a commonly used method for classifying lakes according to trophic condition. The higher the TSI value, the more eutrophic the lake. Each major division of the index (10, 20, 30, etc.) represents a doubling of algal biomass. The index number can be calculated from Secchi disc transparency in meters (SD) as follows: TSI (SD) = 60 - 14.41 (natural logarithm of SD).

Lakes with TSI values less than 40 are classified as oligotrophic (relatively unproductive), those with TSI values between 40 and 50 are considered mesotrophic (moderately productive), and those with TSI values greater than 50 are classified as eutrophic (highly productive) (Allum, et al., 1977; Carlson, 1977).

The eutrophication process is classically defined in terms of natural glacial lakes. Glaciated lakes normally begin as oligotrophic bodies of water with stable quality and long natural succession lives. Increases in productivity of their waters are generally brought about by increasing nutrient concentrations. On the other hand, artificial watershed impoundments in Illinois inundate rich bottom lands and fertile top soils and normally begin their lives with high productivity potential, since mineral nutrients and organic materials are leached from these soils and they are constructed as shallow water bodies. Furthermore, runoff waters from disturbed lands cause high sustained inputs of materials into the lake. Therefore, in terms of nutrient concentrations, sedimentation, and dissolved oxygen deficiencies, many Illinois reservoirs fall into the eutrophic category soon after construction.

POLLUTION

There is no precise, scientific definition of water pollution. Nor is there any one test that can be made of water to determine whether it is polluted. Generally, we say that water is polluted when the properties of water, physical, chemical, or biological, are changed in such a way that either the quality of the water is no longer acceptable for uses which people want to make of it, or the quality is changed in such a way that the natural ecological processes are disturbed. Anything which gets into a lake or river and either changes the natural processes occurring in the water or keeps us from using the water as we would like is a polluting substance.

Water pollution comes in many forms, some more obvious than others. Oils and oil by-products are easily seen glazing the surface of the water. Sediment pollution is seen as an increase in the turbidity of the water, a brown water color, and by the filling in of the upper portion of the lake. Nutrients such as phosphates and nitrates are much less obvious and not apparent until visible increases in weed growth and algal blooms appear. This ever-increasing cyclic growth, death, and decomposition will add to the lake's degradation.

The type of pollution problems a lake has may be determined from the pattern in which its Secchi disc readings fluctuate during the monitoring season; from spatial differences in clarity within the lake; and from field observations of water color, amount of sediment, algae, and aquatic weeds, weather conditions, water levels, and lake management techniques undertaken.

The major pollutants that can be detected from the volunteer Secchi disc monitoring are sediment (which turns the water shades of brown or tan) and nutrients, which act like fertilizers and promote the growth of aquatic plants and algae (which turn the water green, greenish-brown, blue-green, or yellowish).

Locating those areas of the lake that have the lowest Secchi reading and are the brownest or greenest can indicate where sediment and nutrients are most likely entering the lake. Field observations can also indicate other pollution problems.

Seasonal differences in transparency are often apparent and can indicate the type and causes of problems in a lake. In the spring, rainfall is usually heaviest and cropland in the watershed often lacks plant cover, so suspended sediment resulting from soil erosion may turn the lake some shade of brown. The more suspended sediment, the browner the water and the shallower the Secchi disc reading will be.

Some lakes that have severe shoreline or watershed erosion problems remain brown year round, as do shallow lakes in which bottom sediment is resuspended by wind, motor boating, or the activity of bottom feeding fish.

Other lakes may be brown from sediment during rainfall events, then turn green or greenish-brown from algae as the sediment settles out and allows enough light penetration for algae to use the available nutrients for growth. These lakes may be brown in spring and green in summer, or this pattern may repeat itself with rainfall events throughout the year.

Deeper lakes which have less incoming sediment from rainfall events are generally clearer in the springtime. They may remain relatively clear throughout the year, or they may exhibit algae blooms (population explosions of algae) which turn the water green and lessen the transparency. These blooms may be associated with the spring and fall circulation periods (when nutrients which have been trapped in the bottom waters during thermal stratification are distributed throughout the lake and become available for algae growth) or occur during the hot summer months.

Less rainfall during the summer and the development of crop cover in the watershed generally results in less erosion at the time, so a lake with primarily sediment problems may show some improvement. These lakes, as well as those that were relatively clear in the spring, may develop algae blooms during the summer if there is nutrient pollution present.

By the end of September or beginning of October, algae populations often become smaller as water temperatures decrease. The Secchi disc readings will often become deeper again unless soil erosion from increased autumn rainfall increases the sediment input or circulation of nutrients throughout the lake during fall turnover promotes algae blooms.

Virtually everything that occurs in a lake community -- from motorboating to dishwashing, to lawn and garden care -- affects in some way both the lake and the land around it. Land and water use problems cannot be separated from one another; lake pollution problems are largely land use problems. The preservation and protection of the natural resource must be considered a fundamental goal.

Watershed Sources of Pollution

All lakes and rivers are surrounded by land areas which drain into them, either directly or indirectly. Anything which happens within the drainage area or "watershed" of the lake and its tributary streams and rivers influences the water quality in the lake.

The sources of water pollution from upstream areas may include:

Sediment in the form of soil erosion from farms, construction sites in urban areas, from roads, or from stream banks.

Fertilizer and Pesticides washed into the lake or tributary streams (either in solution, or adhering to soil particles) from agricultural areas (such as cropland, pastures, feedlots, manure storage areas, etc.) or from urban areas, as well as from sewage treatment plants which do not remove enough nutrients.

Inadequately Treated Sewage from improperly installed or maintained septic tank/drain field systems near other lakes or streams in the watershed that drain into the lake, or from municipal sewage treatment plants.

Industrial Effluent either from intentional use of the water to carry off waste products from the manufacturing process, or from careless handling of the products which the plant manufactures. Metal processors and chemical manufacturers may discharge metallic substances which are toxic. Food processors and paper mills, on the other hand, may discharge substances which place heavy demands on the dissolved oxygen in the water.

Urban Runoff or surface runoff enters rivers and lakes through storm sewers and drains, and contains virtually every substance which can be "washed" from the land: lawn and garden fertilizers, pesticides, sediment from soil erosion, animal wastes from pets, oil and rubber fragments which wash off streets and parking lots, heavy metals such as lead and zinc, and dirt.

Local Sources of Pollution

While pollution of a lake may be caused in part by harmful substances coming from upstream areas, many of the sources of water pollution are found in the lake community itself.

Some of these local sources of pollution are listed and discussed below.

Faulty septic tank/drain field operation is common because:

- drain fields may be too close to the water table or to surface drains -- the effluent or outflow is not filtered through soil to remove nutrients which stimulate algae production or to remove organic material which uses up oxygen dissolved in the water.

- organic soils (muck) are common on the shores of many lakes. These soils often are saturated with water so that little or no purification of effluent takes place.

- clay soils are not effective filters of septic tank/drain field effluents because they absorb water very slowly, if at all, resulting in surface flows.

- sand absorbs outflows quickly but unfortunately may not filter out all impurities.

- bedrock at or near the land surface does not absorb drain field effluent, resulting in surface flows.

Generally soils that are a mixture of sand and clay work best -- if not overloaded. Soil characteristics and water table factors are very important to the efficient operation of the septic tank/drain field system. The ideal soil-water table situation can become an ineffective filter if the ground becomes saturated and too many septic tank-drain field systems are located in the same area. Also drain fields of homes built back from the water on sloping ground may contaminate the water table of homes down the slope from them.

Erosion. Development around a lake can contribute in many ways to the load of sediment being introduced into the lake. Erosion at the construction sites of new homes, road erosion and shoreline erosion are major sources of this kind of pollution. Hillsides or shore slopes are the most likely spots. Normally vegetation will prevent erosion. But where banks are steep, construction of artificial drainage channels or bank stabilization with railroad ties, steel sea walls, or rip rap may be necessary. A band of natural vegetation left near the shore not only can help curtail sediment reaching the lake but may more effectively prevent nutrients and pesticides from reaching the lake.

Fertilizer and Pesticides. The way individual property owners manage their lawns and gardens also can contribute to the supply of nutrients in the lake. Lawn and garden fertilizers applied to slopes facing the lake or to slopes draining into the lake can stimulate production in the lake as well as the growth of a lawn. Persistent pesticides (lindane, DDT, etc.) washed into the lake kill some beneficial organisms outright, inhibit reproduction of animals, and are accumulated in the fatty tissues of animals, including man.

WATER QUALITY CONTROL MEASURES

While scientists generally agree that most inland lakes are naturally destined to extinction, they also hasten to add that unwise land and water use practices can greatly accelerate the aging process. The signs of lake aging are not hard to recognize; for example, heavy growths of aquatic weeds, algal blooms, fish kills, and thick deposits of sediments and organic matter are indicators that the process may be well along. The speed at which lake aging occurs depends on the amount of chemical nutrients, sediments, and organic material which is carried to the lake from the surrounding land or watershed.

It is usually difficult to know what remedy to apply to a particular lake because each has its own personality. All lakes with the same set of characteristics will not need the same reclamation method. Political, social, and economic factors must be considered, in addition to water quality and lake morphology. There is also the problem that people want prompt action and immediate results while it may take several years for a noticeable change to take place.

Individual Actions

This section suggests some effective and important actions which can be taken by lake residents to help solve both general and specific lake problems. The energy and initiative to institute these actions must come from concerned individuals who are willing to act. These actions not only are an investment in maintaining premium real estate but also an investment in the future of a resource -- an inland lake.

Become Informed

Before urging action, make sure you understand what the problem really is and what the causes are. Study the lake and watershed, identify problems, and determine causes or sources of the problems. Work with the local Soil and Water Conservation District and the Soil Conservation Service to develop a procedure to identify and quantify non-point pollution source areas and identify potential solutions.

It is not necessary that everyone have the expertise to analyze independently and completely every type of problem. In most communities there are "citizen specialists": individuals who have developed an interest in and detailed understanding of some aspect of community affairs and problems. These specialists can be important sources of information and leadership to the entire community. One way an individual citizen can influence and help determine the future of the community is to specialize in a few lake problems and take the responsibility of informing others about them. If many members of the community follow this course of action, it will be the best guarantee of successful lake community management, protecting and preserving the full value of the lake area.

Organize

People get things done through group action. Everyone can participate at least in some small way. Each lake resident should give some time to community affairs by keeping informed and attending meetings. Individuals, groups, and the community at large can act to protect and preserve the lake community.

It is important that the entire lake community take part in decisions. The broader and the more informed the participation in decision making, the less likely is the possibility that decisions will serve only small private self-interests, to the possible disadvantage of the whole community.

Prevent Lake Pollution (from Water Resources Center, 1981)

Lawns. Leave a zone of natural vegetation (a greenbelt of plants and shrubs) as a buffer between lawns and the lake. Shoreline lawns are not recommended. If possible, leave the land in its natural state. Existing lawns should not be overfertilized with phosphorus and nitrogen fertilizer. Do not fertilize unless a soil test indicates that the soil is deficient in some nutrient.

Leaves. Leaves are a source of phosphorus that enrich the water, in turn fostering aquatic weed growth. Leaves should be removed from the lake property during the fall, but should not be burned (because burning concentrates phosphorus in the ashes which are easily washed into the lake by runoff) or stored in the open (because wind and runoff carry the leaves into the water). Composting away from the lake is good. The lake association could organize a leaf pickup program.

Erosion. Correct soil erosion problems. Retain runoff on the site; the soil will filter it. Sloping banks and exposed soil require immediate seeding and mulching to prevent erosion. Normally, vegetation will prevent erosion. A band of natural vegetation left near the shore not only can curtail sediment from reaching the lake but may more effectively prevent nutrients and pesticides from reaching the lake. Stabilize the shoreline with rip rap or some other material to prevent shoreline erosion.

Waterfowl Feeding. Don't feed the ducks! Concentrated use of the lake by waterfowl can add unwanted nutrients and microorganisms to the lake.

Septic Tanks. In addition to being properly designed and constructed in accordance with criteria specified by the Illinois Department of Public Health (1982), regular maintenance must be performed if the system is to function satisfactorily. Settled solids accumulate in the septic tank and must be periodically removed. If not, they are washed into the soil and result in clogging of the absorption field and subsequent failure. It is therefore recommended that the septic tank be pumped at least every three years. Tips for keeping your septic system operating properly are listed below.

Septic Tank Do's and Don'ts:

Avoid excessive use of strong cleaning agents, such as drain cleaners and bleach.

Cigarette butts, hair, facial tissues, paper towels, band-aids, etc., belong in the garbage, not the toilet.

Grease does not break down in a septic tank. Put cooking grease in a can, then into the garbage.

Do not use a garbage disposal unless the septic system was designed to accommodate it; ground up garbage burdens your septic tank.

Be wary of commercial items that claim to clean septic tanks.

If problems arise, investigate cause before using chemical products.

Do not put paint or chemicals down the drain into your septic tank.

Do not put water softener waste brine in your septic tank.

Make a map of the location of your septic tank. Knowing its location is helpful when checking sludge levels or when trying to determine the cause of any problems.

Check the sludge level in your tank every two years. Get it pumped if the sludge and scum level exceeds half of the tank volume.

Your lake association may coordinate a group septic tank pumping program on regular time intervals.

Tilefield Do's and Don'ts

Map the location of your drainfield.

All rain gutters should direct rain water away from the tilefield.

Never build or cement over a tilefield.

Keep vehicles away from the tilefield and septic tank.

A natural strip of vegetation along the water's edge not only stops erosion and filters surface runoff but also intercepts and utilizes nutrients which would otherwise reach the lake.

Signs of Septic System Problems:

Toilets backing up; drains won't drain.

Foul odors around the septic tank and tilefield.

Excessive moisture or surfacing wastewater over the tilefield.

Conserve Water; The Less Water You Use the Better Your Septic System Will Work:

Avoid flushing for trivial reasons.

Plug the bathroom sink when washing or shaving.

Don't use a garbage disposal unless the septic system was designed to accommodate it; they use incredible amounts of water and the ground up garbage burdens your septic tank.

Don't let water run while brushing your teeth.

Use your dishwasher or clothes washer only when you have a full load.

Repair dripping faucets and toilet leaks.

Take showers rather than baths, but limit your shower time. Turn off water when soaping up.

Add a plastic jug filled with water or a brick or two to your toilet tank to save one-half to one gallon of water per flush. An average flush uses 5-7 gallons of water.

Buy water conservation devices like flow control shower heads, low flush toilets and low flush attachments for regular toilets.

Pest Control

Take extreme care in programs to eliminate insect pests and other organisms such as leeches and snails (swimmer's itch). Avoid the use of broad spectrum and persistent pesticides that might create more serious problems by upsetting the natural balance.

Nuisance Weed and Algae Growth

Undertake an environmental monitoring and analysis program; curtail the flow of nutrients which may cause the nuisance growth, including septic tank effluent, inadequately treated municipal wastes, agricultural and feedlot runoff; curtail or stop the use of lawn fertilizers around the lake; enact a soil erosion control ordinance; preserve the natural vegetation on the shore of the lake to serve as a nutrient filter; cut and harvest nuisance aquatic weeds. Use herbicides only when absolutely necessary; chemicals can have possible harmful effects and decaying algae and weeds rob the water of oxygen and fill in the lake.

Public Health

Check the operation of septic tanks to eliminate the possibility of disease spreading from this source; make sure that your water supply is safe to drink; check the quality of water coming into the lake as well as swimming areas for poisons and disease-causing organisms.

Lake Levels

Prevent building in areas subject to flooding. Undertake a continuing program of lake level monitoring aimed at identifying all water sources and predicting lake level changes in advance. Insist on proper controls of upstream development which might otherwise change the inflow of water.

Boating Control

Support the development, enactment and adequate enforcement of boating control regulations; on very small lakes and in some critical portions of larger lakes it may be advisable to forbid the use of high speed boating or all motor boats.

Fish and Wildlife Protection

Limit or forbid filling of shore areas for homes, beaches, boathouses or piers to preserve swamps, bogs and shorelines; support the enactment and the strict enforcement of soil erosion and dredging controls; support laws that protect fish and other wildlife from depletion or extinction; protect vegetative cover including weed beds.

Land Use Control and Zoning

Undertake a long range program of neighborhood and community park and open space acquisition; purchase outright and obtain easements to protect the shoreline; promote adequate zoning and land use controls.

Lake Renewal and Restoration

Seek out applications of technology to improve already deteriorated lakes. Give attention to the basic causes of lake deterioration as well as to the unfortunate results. Some water quality management techniques are summarized in the next section.

Watershed Management and Regional Planning

Recognize that not all lake problems can be solved by local action alone, since many problems have their origin outside the community. Contact and cooperate with the local Soil and Water Conservation District, join an existing or form a new watershed association to help solve watershed problems including flooding, erosion, and water supply. Support special planning and development districts, if needed to solve special areawide problems. Support public works designed to protect and improve water quality.

Get Government to Act

Become familiar with the people and procedures involved in government of the lake community.

Be able to explain the nature and extent of the particular problem. Read up on the subject; talk or write to experts in the field at nearby universities or colleges or in state agencies.

Be able to explain what it is you want the government unit to do and make sure it has the power to do it.

Inform the entire community of the plan of action and check to see if they generally agree.

Identify sources of support throughout the community, such as the Jaycees, the Chamber of Commerce, fraternal, religious, and other civic associations, conservation organizations, township or county planning commissions and governing boards.

Communicate your concerns in an organized and forceful manner to the responsible governmental officials. Meet with, call and write both elected and appointed officials and support them in their efforts to solve lake problems.

Participate personally in both community and local government affairs. Attend board and commission meetings even when nothing is on the agenda that specifically relates to lake problems. Vote in all local elections and support people responsive to lake management problems.

Indicate willingness to pay for the needed services to solve lake problems. Help officials who initiate programs bring them to a successful conclusion by urging your neighbors and friends to follow-up their concern with dollars for projects and with votes for public officials who will cooperate.

Review of Water Quality Management Techniques

This section will attempt to summarize the various lake protection and management techniques available, the advantages and disadvantages of each, and the situations in which they are applicable. It is modified from Sefton (1978).

It must be remembered that before any of the following techniques are used a feasibility study should be made which assesses the lake problem, evaluates the needs of the community, evaluates the use of several techniques, and compares the cost of each. Most of all, the intended use of the lake should be clear before deciding on any lake reclamation technique.

Approaches to lake water quality management fall into two general categories:

1. Limiting the influx of pollutants (i.e., protecting the lake from water quality degradation) and
2. In-lake treatment or control measures (i.e., management or restoration).

Lake Protection

Lake protection involves pollution abatement or control measures to prevent pollution from entering a lake, including methods to reduce the pollutant load at its source or to impede its delivery to the lake.

Pollutant influx is recognized as the primary factor degrading lake systems. Internal recycling of pollutant loads tends to perpetuate polluted conditions; but since this process is generally not 100 percent efficient, the quality of the system will usually improve after a period of time, unless pollutant addition from external sources continues.

It is generally agreed that the most desirable long-term lake management approach is to control the influx of pollutants. This is particularly true for Illinois lakes, where watershed runoff greatly influences quality and longevity. However, there is considerable disagreement regarding the pollutant sources to be controlled, the methods for control and the benefits to be gained.

Lake protection measures involve processes such as municipal and industrial wastewater treatment and diversion to control point sources of pollution, and structural or land treatment measures or regulatory approaches to control nonpoint sources of pollution. Methods and strategies for controlling these sources of pollution in Illinois are described in the Illinois EPA's statewide 208 Water Quality Management Plan (Illinois EPA 1979); therefore, they will only be summarized here.

Wastewater Treatment. Wastewater treatment at both municipal and industrial sources is perhaps the most widely used technique for reducing the pollutant loads of waterways.

Control of discharges from industry and municipal sewage systems (point sources) is handled in Illinois under a regulatory structure established by the Illinois Environmental Protection Act and Illinois Pollution Control Board rules and regulations. Stringent water quality standards and limits for pollution levels of all discharges were set under these regulations. The National Pollution Discharge Elimination System (NPDES) permit program incorporates effluent limits into the discharger's permit.

Planning, design and construction of municipal wastewater treatment facilities are being accomplished through state and federal construction grant programs. The Illinois EPA reviews plans and specifications for proposed wastewater treatment facilities. This review assures that the design of the treatment facility is adequate to meet the effluent limits contained in the NPDES permit. Regulations also help prevent overloading of existing sewage systems and discharges of toxic pollutants.

Diversion. Diversion is the re-routing of waters so that they do not enter a lake. The inflowing stream could be permanently diverted around the lake if its water quality is sufficiently low to degrade the lake. Physical considerations may restrict the use of this technique: the re-routed water may be needed for a water supply lake to keep it from drying up. A variation of this technique is to only divert those waters around the lake which are high in pollutants (such as stormwater runoff).

Land Use Practices. Indirect or nonpoint sources of pollution which are incidental to land uses throughout the watershed of a lake are a major cause of lake degradation in Illinois. Agricultural runoff, urban stormwater, septic tanks, mining activities or runoff, and other nonpoint pollution sources contribute greatly to lake water quality degradation from nutrients, sediments and other contaminants.

Efforts to limit nutrient and sediment inputs from lands within drainage basins have followed two general lines: (1) structural and land treatment measures to intercept pollutants before they reach water bodies and (2) regulatory approaches, particularly land use controls, to restrict uses with direct or indirect pollution potential or effects. The first approach is typified by the activities of the Soil Conservation Service of the U.S. Department of Agriculture, which is involved with land use conservation programs, largely on rural lands. Programs have been promoted by extensive educational efforts and facilitated by providing technical assistance and cost-sharing incentives. The second approach is illustrated by shoreland (land areas immediately adjoining the lake) protection programs such as Wisconsin's joint state-local regulatory zoning of shorelands around lakes.

The feasibility and effectiveness of nonpoint pollution control is dependent upon the application of programs to critical areas significantly affecting lake water quality during use periods.

Structural and Land Treatment Measures. The number one nonpoint source pollutant by volume in Illinois is sediment. The most fundamental concept of sediment control is prevention of soil erosion. The Illinois Water Quality Management Plan (Illinois EPA, 1979) describes in detail resource management systems and conservation practices and measures to intercept, retard or otherwise control runoff and thus prevent soil erosion. Erosion control and stabilization of lake shorelines can be accomplished by both structural and vegetative means. Resource management systems to limit sediment pollution include: conservation cropping systems; conservation tillage; contour farming; cover crop; critical area planting; crop residue use; debris basins; diversions; field borders; grade stabilization structures; land use change to conservation use; livestock exclusion; mulching; preservation of permanent vegetation; water areas and wetlands; land grading; proper site selection (for construction); restricting the size of disturbed areas; roof gutters, downspouts and outlets; streambank or lakeshore stabilization structures (e.g., rip rap); stripcropping; terraces; timing of construction activities; tree planting; waterways; and greenbelts.

Sediment traps or basins may be constructed to retard tributary flows and thus trap sediment in addition to serving as fish rearing areas. Water may be diverted through natural basins, or dams may be constructed to form artificial basins. Natural wetland basins may be used to purify water in three ways: 1) physically - a reduction in water velocity with consequent precipitation of sediment; 2) biologically - slow moving water gives aquatic plants longer time to tie up nutrients; and 3) nutrient absorption by bottom deposits. A probable removal of 80 percent phosphorus and 90 percent suspended solids may be expected (MacLennan 1976).

Regulatory Approaches. Land use control is especially important in the immediate watershed where danger of sediment input is greatest. To reduce the amount of nonpoint pollutant input to a waterway, some type of land use regulation, preferably at the local level, must be administered. Pollutant input restriction may be accomplished by both direct and indirect methods.

Direct purchases or easement acquisition of critical areas may be accomplished on a local, state, or federal level to obtain direct control of land for purposes of limiting pollutant inputs. Indirect or legislative methods include soil-loss (or pollution) limitation through promulgation of Resource Management Systems, development of soil loss standards, and critical area zoning.

Soil Conservation Districts may be given the responsibility of developing soil-loss standards and guidelines for best land management practices. If sedimentation should exceed the standards of a district, then legal action may be initiated by the district against the alleged violator.

Natural resource protection zoning designations may be promulgated. For example, in South Dakota, a "Lake Park District" provides for orderly limited residential and recreational development together with certain public facilities, customary occupations, and certain recreation oriented commercial establishments along lake shores. A "Natural Resource District" provides for retaining of natural vegetation of a particular area to preserve the natural environment and resources from destructive land uses and protect wildlife habitat (State Lakes Preservation Committee, 1977).

Treatment of Inflow. The treatment of all or part of the inflow is a potential method of controlling sediment or nutrient additions to a lake. Treatment of the inflowing waters may be justified where: 1) the sources of nutrients or sediment are so diffuse that they cannot be controlled individually, and diversion is unacceptable; or 2) the economics of abatement preclude small-scale treatment works in favor of a more efficient large scale system (Dunst., *et al*., 1974).

Product Modification. Certain commercial products are capable of influencing the rate of lake degradation. Detergents and chemical fertilizers containing plant nutrients which are rapidly transported to lake systems may accelerate eutrophication. Pesticides and other products may contain chemicals which are harmful to organisms. Restricting the use of those products, modifying application procedures for them, or modifying them to contain nonharmful materials may be viable methods of lake protection.

In-lake Treatment or Control Techniques

In-lake treatment or control techniques fall into two general categories: 1) methods to limit the availability of pollutants already in the lake or to accelerate their outflow; and 2) various physical, chemical, and biological approaches for managing the consequences of degradation and enhancing the usability of the lake without controlling the source of the degradation. Many of these in-lake techniques may fall into either category depending on the particular lake being considered. Excellent summaries of these techniques are provided in Dunst, *et al*. (1974) and USEPA (1973). The following review is based primarily on information given in those publications.

Dredging. Since lake sediments represent a potential pollutant source, sediment removal (dredging) is often advocated as a means of reversing or retarding degradation. It may improve the quality of a lake by uncovering a layer that does not contain or release appreciable quantities of pollutants. It is also a cosmetic approach to enhance the usability of a lake without controlling the source of degradation.

Physical removal of sediment deepens the lake, increasing its storage capacity, expanding the area usable for recreation, decreasing the littoral area available for plant growth, and creating a greater volume of oxygenated water. Lake deepening by dredging may also help reduce the sediment resuspension by wind or by waves from recreational activity.

Dredging methods may be either mechanical or hydraulic. A detailed discussion of the various types of equipment and methods employed in lake dredging is given in Pierce (1970).

Several disadvantages to dredging have been cited. Dredging operations are expensive. The pollutant concentrations in the sediment may remain high to a considerable depth, making it impossible to reach a low pollutant level in the sediment and thus utilize the technique for removing the pollutant. Dredging is not usually considered as having water quality benefits if watershed runoff having significant levels of pollutants can still enter the lake. It is often difficult to find environmentally safe or economically feasible sites for disposal of spoil material. Dredging may create abnormal turbidity and resuspend pollutants which may persist for some time afterward. The suspension of the sediment may substantially increase the oxygen uptake and cause release of other contaminants to the overlying water.

A successful project on sediment removal and reuse is underway at Lake Paradise, Coles County, Illinois.

Lake Bottom Treatments. Instead of removing nutrient or pollutant rich sediments from a lake, it may be more cost-effective to treat the sediments. Covering of the bottom sediments with sheeting materials (plastic, rubber, etc.) or particulate material (sand, clay, etc.) can retard the exchange of nutrients and other pollutants from the sediments either by forming a physical barrier or by increasing the capacity of the surface sediments to hold them. Some coverings such as fiberglass screens may also inhibit weed growth by affecting their rooting substrate (USEPA, 1981).

Sylvester and Seabloom (1965) suggested covering reservoir soils with sand prior to inundation to retard release of nutrients and metals, thus protecting water quality. In laboratory studies, several centimeters of sand were effective in suppressing nutrient release from the reservoir soils.

The permanence of these bottom treatments is questionable. Gas production in the underlying sediments may cause ballooning of the sheeting or rupturing of the seal. Failure to control pollutant inputs may negate the treatments and not result in long range improvements. Other problems are related to the possible adverse effects of the treatment on aquatic life and the high cost.

Inactivation/Precipitation. This in-lake technique involves adding some material to the water that will either (1) change the form of the nutrient or pollutant to make it unavailable or harmless; (2) remove the nutrient or pollutant from the euphotic zone; or (3) prevent release or recycling of potentially available nutrients or pollutants within the lake.

In-lake inactivation/precipitation techniques have been primarily directed toward controlling phosphorus. Precipitation and removal of suspended solids reduces nutrient levels as well. Agents which have received the most attention are aluminum, iron and calcium salts. Of these three, aluminum appears to be the only one applicable to lakes in Illinois (Kothandaraman, 1981). Purifloc-31 has been used on an experimental basis on small ponds having problems with turbidity to precipitate inorganic suspended solids and clarify the water. (Dunst, *et al.*, 1974).

This technique would be most applicable to lakes with 1) a maximum depth in excess of 15 feet; 2) stratification occurring throughout the growing season; 3) problems related to algal growth rather than rooted vegetation; 4) detention time of one year or longer; and 5) minimal pollutant inputs from the watershed. (Uttormark and Wall, 1975).

The major drawbacks cited against in-lake inactivation/precipitation are:

1. The treatment is expensive, primarily due to manpower costs.
2. Introduction of metallic salts may have deleterious effects on biota.
3. The material which is precipitated could have adverse biological effects, i.e., suffocate aquatic organisms or interfere with the benthic ecosystem.
4. Dissolved solids in the water may increase to an unacceptable level with the addition of certain salts.
5. Little is known of the effective duration of the treatment.
6. Effects may be temporary if pollutant sources are not controlled.

Inactivation/precipitation may also be accomplished by pumping water out of the lake for an external treatment process and then returning it.

Dilution/Flushing. This technique improves water quality of some lakes by diluting or replacing existing water with water of a higher quality. High quality replacement water must be readily available. Water replacement can be accomplished in two ways: 1) by adding high quality water which displaces an equal volume of lower quality water or 2) by removing existing water or selectively withdrawing poor quality water and relying on natural ground or surface water recharge for replacement.

Investigations have shown that this method does not work well if sufficient nutrients or pollutants are present in the sediments to leach into the high quality water filling the lake. However, if suspended particulates and deposition of sediment are a problem, this technique could be very effective, particularly if combined with lake level manipulation or selective discharge.

Sediment Exposure and Dessication. Water level manipulation has been employed as a mechanism for enhancing the quality of certain lakes. Drawdown exposes nutrient rich sediments. Exposure of sediments to the atmosphere can substantially reduce the the sediment oxygen demand and increase the oxidation state of the surface layer, thereby retarding the movement of phosphorus from the sediments. Nutrient release may also be curbed by the physical stabilization of the upper flocculent zone of sediments.

Lake drawdown has also been investigated as a control measure for submerged rooted aquatic vegetation and as a mechanism for lake deepening through sediment consolidation.

For a reservoir with water level control structures, this may be a relatively inexpensive water quality management and fisheries technique. This procedure could be combined with dilution/flushing or dry dredging to achieve multiple objectives. However, it does have problems that limit its usefulness. Sediment consolidation may effect only temporary lake deepening since sediment expansion may occur upon refill. The method is conditioned on predictable recharge surpluses and popular acceptance of the complete kill of fishes which may attend such an operation if the lake is completely drained.

Selective Discharge. This technique increases the amount of dissolved oxygen throughout a lake and/or increases nutrient and sediment outputs from a lake by releasing anaerobic nutrient-and/or sediment-rich waters from a selected area (generally the bottom) of the lake. This is done through outlet controls or the use of pipes extended to the bottom of the lake. Selective discharge is limited to lakes with recharge waters capable of sustaining losses or where additional high quality water may augment inflows.

Selective discharge, combined with dilution/flushing, may be a relatively inexpensive, effective water quality management technique for reservoirs. However, it also has some problems which limit its utility. The removal of cooler water from the bottom of the reservoir may result in elevated temperatures at the lower depths. As a consequence, the rate of chemical reactions may be greatly accelerated in the bottom waters, thus placing an increased demand on the oxygen resources. The increased temperature may also adversely affect aquatic life. In addition, the discharge of anaerobic water, accompanying gases and other pollutants may cause serious problems downstream. This problem may be overcome, however, if the water to be discharged is aerated before it is released downstream.

Aeration and/or Circulation. Circulation and aeration by mechanical means is a common method of increasing the use potential of lakes. The basic objective of virtually all aeration projects is improved dissolved oxygen conditions for fisheries resources or water quality management purposes.

The terms total aeration and artifical destratification refer to the technique of increasing the dissolved oxygen content of the bottom waters of lakes by eliminating thermal stratification and homogenizing the entire water volume. Destratification is usually accomplished by either mechanical water pumps or compressed air released at the lake bottom. The cooler denser bottom water is lifted to the lake surface where it mixes with the warmer epilimnetic water and absorbs oxygen before sinking back. As the mixing process continues, complete circulation is achieved and the lake approaches uniform temperature and dissolved oxygen conditions from the surface to the bottom. The whole water mass becomes inhabitable by lake biota.

The Illinois State Water Survey has utilized this technique successfully in Lake Catherine on the Fox Chain of Lakes (Kothandaraman, et al., 1980) as well as at Lake Eureka, a public water supply impoundment in Woodford County, Illinois. Lake Eureka had been abandoned as a water supply because of persistent and severe taste and odor problems. Aeration of the lake restored its usefulness and saved the City over $25,000 per year in costs of pumping groundwater from an alternate source. The total cost of the aeration system was $8,400 and operational costs were approximately $60 per month. (Kothandaraman and Evans, 1982).

Some benefits of aeration and circulation are:

1. Oxidation of reduced organic and inorganic materials occurs in the water. This is particularly advantageous when the lake serves as a public water supply, because taste, odor, and color problems caused by iron, manganese, and/or hydrogen sulfide are eliminated or at least minimized.

2. With increased oxygen resources in the entire lake, there is a reduction in the anaerobic release of nutrients and toxic materials from the bottom sediments and a greater volume of water to assimilate waste. It can thus provide an efficient means of overriding the significant nonpoint source load.

3. The range of benthic, fish and plankton populations is greatly enhanced by providing greater depths and volumes of livable habitat.

4. Favorable changes in algal populations may occur with a decrease in undesirable taste and odor producing blue-green species and increased water clarity may be associated with reduced algae problems.

5. Evaporation rates are reduced due to reduced surface temperatures.

6. Summer and winter fish kills may be prevented by maintaining sufficient oxygen levels.

7. The aerator may serve as a fish attractor, centralizing fish and increasing catch rate.

Kothandaraman, et al. (1980) and Kothandaraman and Evans (1982) found these advantages to be demonstrated with aeration for Lake Catherine and Lake Eureka.

Disadvantages of aeration and circulation are:

1. It is a temporary, cosmetic measure that does not reduce the incoming pollutant load.

2. Turbidity may be increased due to resuspension of bottom sediments if the aerator is not properly placed.

3. Artificial destratification may induce foaming.

4. Increased sediment temperatures associated with destratification may lead to accelerated nutrient release (Fast 1971).

5. Artificial destratification increases the heat budget of the lake, and thus may diminish or even eliminate potential cold water fish habitat and the cool hypolimnetic water preferred by municipal and industrial water supplies.

In recognition of this last disadvantage, several types of aeration devices have been designed to improve dissolved oxygen conditions in the hypolimnion of stratified lakes without disrupting thermal stratification. In investigations at Lake Catherine and Lake Eureka, Illinois by Kothandaraman, et al. (1980) and Kothandaraman and Evans (1982), most of the detrimental effects listed above did not materialize.

Weed Control Measures. Weed control measures include mechanical cutting and harvesting, application of aquatic herbicides, habitat manipulation, and manipulation of biotic interactions.

Mechanical cutting of weeds immediately improves the appearance and visibility of a lake. Removal of the cut weeds from the lake is especially important so that they are not available to deplete the dissolved oxygen in the water, release nutrients for new plant growth, or spread by vegetative growth.

Macrophytes may also be controlled by chemicals if the proper herbicide is selected and correctly applied. Chemical treatment has the greatest utility and justification in highly eutrophic lakes in which the nutrient supply can not be effectively controlled or in which nutrient input control measures are envisaged in the future. Problems with chemical controls relate to their temporary nature, their possible detrimental effects on aquatic organisms, their possible accumulation in animal tissues, their deleterious effects on other uses such as municipal or industrial water supply, and the fact that the organisms are not removed and thus create an oxygen demand and release nutrients upon decomposition.

Habitat manipulation for aquatic weed control involves deepening the lake by sediment consolidation, dredging, or artifically raising the lake level on a permanent basis; fluctuating lake levels (flooding or drawdown) to influence species composition and density; substrate alterations; use of fiberglass screens; and controlling the amount of light available for photosynthesis and thus plant production. Light controls may be in the form of a dye or other material (such as a sheet of black plastic) that floats on the surface of the water. These two types of light controls can only be used on a small scale basis due to their obvious detraction from the aesthetic and recreational use of the lake.

Biological control encompasses the introduction or promotion of organisms that are inimical to the target organisms. For example, dense blankets of phytoplankton inhibit the growth of aquatic macrophytes, both by direct competition for nutrients and by shading. Other biological control measures are only in the developmental stages, and therefore will not be discussed here.

Algae Control Measures (from Kothandaraman, 1981). Copper sulfate is probably the most widely used chemical for control of blue-green algae, taste and odor producing algae, and some filter clogging algae. Over 10,000 tons of copper sulfate are used for this purpose each year in this country at concentrations ranging from less than 0.5 mg/l to more than 10.0 mg/l (Fitzgerald, 1971). The amounts of oxygen, organic matter, and alkalinity in the water determine the dosages required for effective plankton control (Fitzgerald, 1971; Mackenthun, 1969). For waters with alkalinity greater than 40 mg/l, copper sulfate at a rate of 1 mg/l for the upper 2 feet of water regardless of actual depth has been widely used (Mackenthun, 1969). On an acreage basis, the concentration would amount to 5.4 lbs/surface acre. For lakes with alkalinity less than 40 mg/l, a concentration of 0.3 mg/l of copper sulfate amounting to 0.9 lbs/acre has been suggested. The difference is mainly due to the fact that the effectiveness of copper sulfate is reduced in high alkalinity waters because of the formation of an insoluble precipitate of copper basic carbonate. Chelated copper sulfate (cutrine), which does not precipitate as readily as copper sulfate, has been employed successfully in controlling noxious algal blooms (Dunst, et al., 1974).

Copper sulfate has a low mammalian toxicity, is inexpensive, and is effective in controlling a wide range of plankton algae. However, instances of fish kills have been reported soon after copper sulfate applications. These were generally traced to improper application and excessive dosage rates. The toxic effect of copper sulfate on plants is caused by the inactivation of enzymes and precipitation of proteins by the divalent ion CU^{2+}.

Copper sulfate may be applied in a variety of ways: bag dragging, dry feeding behind power boats, liquid spray, or airplane application of either dry or wet material.

Chemical algal control measures should be undertaken before the maximum development of algal blooms. Mackenthun (1969) suggests that it is a good practice to subdivide the total area into sections and control the nuisance in one section followed by treatment of other sections at intervals of 7 to 10 days. This procedure will ensure that sufficient dissolved oxygen is present to satisfy the demands of the decomposing algae.

The frequency of copper sulfate application varies from a single annual application to monthly applications during spring and summer. The continuous feed of copper sulfate to the inlet of a reservoir has also been reported (Muchmore, 1973).

While copper sulfate may be an effective temporary control measure, there is concern for the long-term build-up of copper in the bottom sediments through continued use. Use of it causes the same problems as weed control by other chemicals.

Fish Control Measures. Manipulation and control of fish populations is the objective of fisheries management and therefore will not be discussed here. Suffice to say that elimination of undesirable fish species, especially through harvesting, can improve the conditions of a lake.

Control of In-lake Activities. The type and intensity of lake usage (e.g., swimming, boating, fishing) also affect its quality. In-lake activities may add litter and other contaminants and stir up the bottom sediments, creating turbid conditions and nutrient and contaminant release. Therefore, consideration might be given to boat speed and size, channel (area), or other usage restrictions in lake specific water quality management plans. Since different uses may require or be compatible with differing water quality and quantity, a lake may be zoned for various uses. A portion of a lake may even be designed to serve as a settling basin for detention and possible treatment of wastes.

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SECTION VI. GLOSSARY*

acre-foot - the volume of water required to cover one acre to a depth of one foot and equal to 0.3258 million gallons; a unit of storage capacity obtained by multiplying surface area (in acres) by average depth (in feet).

aeration-destratification or aeration/circulation - the addition of air to the water through mechanical means to increase the dissolved oxygen content of the bottom waters of lakes by eliminating thermal stratification and circulating the entire water column.

aerobic - conditions characterized by the presence of oxygen.

algae - one-celled or colonial photosynthetic plants (usually microscopic), found suspended in water or attached to damp rocks or other substrates.

algal bloom - a large number of planktonic algae, which often turns the water green and may produce objectionable scums and odors; a condition in which algae cloud the water noticeably.

ambient - existing condition or level at the time and place.

ammonia - a colorless, gaseous, alkaline compound which is a decompositional end product of nitrogen-containing organic matter; its importance in fresh water is associated with its toxicity to aquatic organisms and its use as a nutrient for aquatic plant growth.

anaerobic - conditions characterized by the absence of oxygen.

anoxic - without oxygen.

aphotic zone - that part of a water body to which light does not penetrate with sufficient intensity to maintain photosynthesis.

aquatic - growing or living in water; pertaining to water.

aquatic weeds - larger plants easily visible to the naked eye which are submergent, floating or emergent in the water.

area - size of the water surface of the lake

artificial - man-made; constructed.

artificial watershed impoundment - lake created by damming a stream.

average depth - mean depth of a lake, calculated by dividing the volume (storage capacity) by the surface area.

backwater (or river backwater) - water impoundment located along the side of a stream or river which may flood periodically or have a direct connection to the stream at all times.

bathymetric - relating to the measurement of water depths, as for a lake.

benthos - the community of organisms associated with the bottom sediments in a body of water.

biomass - existing amount (standing crop) of organisms present in a lake; expressed as weight per unit area.

biotic - biological; pertaining to living organisms.

blue-green algae - a group of one celled or colonial plants of the phylum Cyanophyta, which live in water or damp places and reflect a blue to dark green tint; most often responsible for nuisance algal blooms with scum and odors.

borrow pit - a water impoundment formed by removal of earth for fill construction in the making of roads, dikes, bridges and levees

bottomland lake - natural water impoundment located in a river floodplain

chlorophyll - a green-colored pigment found in plants.

compensation level - the depth at which oxygen production by photosynthesis balances oxygen uptake by respiration.

circulation period - mixing period for a lake; period of time in which the entire lake volume is not thermally stratified and is totally mixed by wind action.

clarity - transparency, visibility into the water.

condition - the overall quality of the lake for supporting general use

consumers - organisms that are unable to manufacture their food from nonliving matter and that feed upon other organisms.

copper sulfate - $CuSO_4$; a chemical used for control of algal blooms.

cultural eutrophication - the acceleration of the natural aging, or enrichment, process of a lake as a result of man's activities.

cutrine - a copper sulfate solution used for treating noxious algal blooms.

decomposers - organisms, mostly bacteria or fungi, that break down complex organic material into its inorganic constituents.

decomposition - breakdown into basic units detritus - finely divided organic and inorganic settleable material suspended in the water

diatoms - a group of one-celled or colonial algae living in water or damp places which are characterized by the presence of yellow-green or brown pigments and cell walls which contain silica and are composed of two halves (valves), one overlapping the other like the top and bottom of a pill box

dilution/flushing - a technique for improving lake water quality by diluting or replacing existing water with water of higher quality.

diversion - rerouting of waters so that they do not enter a lake.

duckweed - small, green aquatic plants floating on the surface of the water.

drainage area or drainage basin - watershed; the land surface surrounding the lake which contributes water via surface runoff to the the lake

dredging - removal of lake bottom sediments.

ecology - the study of the relationship of organisms to their environment

ecosystem - the community of plants and animals interacting together within the physical and chemical environment.

emergent - a rooted aquatic plant with parts normally extending above the water surface.

epilimnion - upper, relatively warm, circulating zone of water in a thermally stratified lake.

erosion - wearing away of the soil.

euphotic zone - region of a lake where light penetration is sufficient to maintain photosynthesis; its lower limit is generally two to five times the Secchi disc transparency.

eutrophic - waters which are rich in plant nutrients and capable of supporting high biological productivity; USEPA defines a eutrophic lake as one that exhibits any of the following characteristics: biomass accumulations of primary producers (algal blooms and excessive aquatic weeds); rapid organic or inorganic sedimentation and shallowing; or seasonal dissolved oxygen deficiencies in the bottom waters and subsequent shift in species composition of aquatic fauna to forms that can tolerate lower concentrations of oxygen.

eutrophication - lake aging through nutrient enrichment and sedimentation.

fall overturn - a natural mixing of thermally stratified waters that commonly occurs during early autumn. The sequence of events leading to fall overturn includes (1) cooling of surface water, (2) density change in surface water that produces convection currents from top to bottom, and (3) circulation of the total water volume by wind action. The overturn generally results in a uniformity of the physical and chemical properties of the water.

fauna - animals.

fertile - waters rich in plant nutrients.

fertilizer - manure, chemicals, etc. containing nutrients to enrich the soil and aid in plant growth.

floating-leaved - aquatic plants with leaves floating on the surface of the water.

floc - suspended material of large volume which is light and resistant to settling.

flora - plants.

flush - water renewal time.

food chain or food web - the transfer of food energy and materials from plants through other organisms, with repeated eating and being eaten.

glacial lake - body of standing water formed by glacial action.

green algae - a group of one-celled or colonial plants of the phylum Chlorophyta, which live in water or damp areas and reflect a greenish tint.

harvesting - cutting and removal of aquatic plants from the lake.

headwaters - in a reservoir created by damming a stream, the upper, shallower end of the lake where the major tributaries enter.

herbicides - any chemical substance used to destroy plants, especially weeds.

hydraulic - related to the movement of water

hydrologic cycle - the cycling of water from the earth to the atmosphere, in the form of evaporation and transpiration, and back to earth in the form of precipitation.

hydrology - study of water movement.

hydrogen sulfide - a gaseous compound produced under anaerobic conditions which has a rotten egg smell.

hypolimnion - lower, relatively cold, noncirculating zone in a thermally stratified lake.

impairment - that which damages or negatively impacts the present or potential use of a body of water.

impoundment - a body of standing water constructed by artificial means or formed by nature.

inactivation/precipitation - a technique for improving water quality which involves adding some material to the water which will make nutrients or pollutants harmless or unavailable.

inorganic - not organic; not of, like, or derived from living organisms

in-lake treatment or control techniques - methods to limit the availability of pollutants already in the lake or to accelerate their outflow; and various physical, chemical and biological approaches for managing the consequences of degradation and exhancing the usability of the lake without controlling the source of the degradation.

invertebrates - small animals which do not have backbones or spinal columns.

iron - an essential micronutrient, which is considered objectionable in water supplies because it can cause taste and odor problems and stain laundry.

lake - a body of standing water 6.0 acres or more in surface area (as defined by the Illinois Department of Conservation).

lake bottom treatments - a technique for improving lake water quality by covering the bottom sediments with sheeting or particulate material.

lake code - an eight-digit combination of letters and numbers used to identify a lake in the computer.

larva - an early immature form of any animal that changes structurally when it becomes an adult.

limnologist - aquatic ecologist; one who studies the physical, chemical, and biological aspects of lakes.

limnology - the study of the ecology of inland lakes.

littoral - shoreward region of a body of water.

logarithm - the exponent indicating the power to which a fixed number must be raised to produce a given number.

macroinvertebrates - animals lacking backbones which are large enough to be easily visible to the naked eye.

macrophyte - large plant of macroscopic size (easily visible to the naked eye).

management - non-structural measures designed to enhance the quality and usability of a lake.

manganese - an essential micronutrient, which is considered objectionable at high concentrations because it can cause taste and odor problems.

maximum (max) - highest (largest) value observed in a data set.

maximum depth - depth of deepest point in a lake.

mean - a statistical term for average, calculated by totalling the values and dividing by the number of observations.

mean depth - the volume of a lake divided by its surface area; average depth.

mesotrophic - waters intermediate in character between oligotrophic and eutrophic; moderately well supplied with plant nutrients and capable of supporting moderate biological productivity.

metalimnion - thermocline; the middle layer of water in a thermally stratified lake in which temperature decreases rapidly with increasing depth.

methane - a colorless, odorless, flammable, poisonous gas resulting from decomposition of organic material in the absence of oxygen; is present in marsh gas and natural gas.

microscopic - so small as to be invisible except through a microscope; minute.

minimum (min) - smallest (lowest) value observed in a data set.

mixing period - circulation period of a lake; period of time in which the lake is not thermally stratified and is totally mixed by wind action.

morphology - study of configuration or form (size, depth, shape)

morphometry - the measurement of the shape characteristics of lakes and lake basins.

natural lake - a body of standing water formed by natural (not man made) forces (e.g. glacial action, rivers, etc.).

nitrogen - an element which is an essential plant nutrient and is one of the principal elemental constituents of proteins.

nonpoint pollution - pollution from diffuse sources (e.g., agriculture, forestry operations, mining, construction) for which a specific point of discharge cannot be readily identified.

nutrient - any chemical element, ion or compound that is required by an organism for the continuation of growth, reproduction and other life processes; nitrogen and phosphorus are usually growth limiting factors for aquatic plants.

nymph - a young, immature stage of an insect.

oligotrophic - waters with low concentrations of plant nutrients and hence capable of supporting little biological productivity.

organic - containing carbon; of, like, or derived from living organisms.

organizational impoundment - body of standing water owned, leased or maintained by an organization of six or more members (as defined by the Illinois Department of Conservation).

overturn - mixing period for a lake; period of time in which the entire lake volume is not thermally stratified and is totally mixed by wind action.

oxbow lake - a shallow, crescent shaped natural lake formed from a broad stream meander or bend which has been cut off from the main river.

pesticides - any chemical substance used to destroy insects or other pests.

pH - an index of the hydrogen ion activity of the water and a measure of its acid or alkaline nature.

phosphorus - an element which is an essential plant nutrient and plays a vital role in the energy transfer during cell metabolism.

photosynthesis - the process by which green plants use the sun's energy to convert dioxide and water into chemical energy (carbohydrates, fats, and proteins).

phytoplankton - microscopic plants (algae) that drift passively in open water regions of lakes and rivers.

plankton - the community of microscopic plants and animals that drift passively in open water regions of lakes and rivers.

planktonic - being part of the plankton community of plants and animals that drift passively in open water regions of lakes and rivers.

point source pollution - pollution eminating from a discharge point such as a pipe which can be specifically identified (e.g., sewage treatment plants, manufacturing plants).

pollution - any substance which makes another unclean or impure.

pond - small body of standing water less than 6.0 acres in surface area (as defined by the Illinois Department of Conservation).

potable - of quality for drinking.

private impoundment - body of standing water privately owned or leased with no fee charged for use (as defined by the Illinois Department of Conservation).

precipitation - settling out and depositing; rainfall.

producers - organisms that are able to build up their body substance (organic material) from inorganic materials (dissolved minerals and gases).

production - total amount of living matter produced in a lake per unit time.

productivity - rate at which organic material (and energy) is produced and transferred through organisms in an ecosystem; standing crop of organisms that can be supported.

protection - pollution abatement or control; measures to prevent pollution from entering a lake, including methods to stop the pollution at its source or to treat it before it reaches the lake.

public access - publicly owned contiguous land or easements providing any member of the public the same or equivalent opportunity to enjoy privileges and benefits of the lake as any other member of the public or as any resident around the lake.

public impoundment - body of standing water owned and maintained by a governmental agency (excluding the Illinois Department of Conservation) that have public access.

public water supply - used as a municipal water supply for domestic needs.

pupa - an insect in the stage between larval and adult forms.

quadrants - quarters.

Resource Management Systems - best management practices for the control and abatement of nonpoint pollution; a combination of agricultural practices which reduce soil erosion and/or increase water retention.

respiration - release of energy by oxidation of fuel molecules; taking in of oxygen and release of carbon dioxide.

restoration - structural measures designed to return a lake to its original condition (e.g., dredging to original depth).

reservoir - a watershed impoundment artificially constructed by damming of a stream.

retention time - water residence time; period of time a mass of water remains in an impoundment.

rip-rap - materials, particularly large rocks or pieces of cement, used to stabilize an eroding shoreline.

river backwater - water impoundment located along the side of a stream or river which may flood periodically or have a direct connection to the stream at all times.

resuspend - cause to be suspended in the water.

river basin - drainage area for a large river.

seasonal - over a period of time (seasonal).

Secchi disc - an eight-inch diameter weighted metal plate painted black and white in alternating quadrants which is lowered into the water on a calibrated line to measure the transparency or clarity of the water.

Secchi disc depth, Secchi disc transparency, or Secchi disc reading - the depth into the water to which a black and white circular disc can be seen when viewed from the surface; a measure of water transparency or its ability to allow vertical light penetration.

sediment - the solid materials (particulate matter) transported by, suspended in or deposited from, water; includes fragmentary material that originates from weathering of rock, chemical and biochemical precipitants and decomposed organic material such as humus.

sediment exposure and dessication - a lake water quality management technique which involves drawdown of the water to allow the sediment to be exposed to the air and dry out.

sediment-related turbidity - muddiness; cloudiness or opaqueness of the water caused by suspended sediment.

sedimentation - deposition of organic and/or inorganic particulate matter.

sedimentation surveys - measurement of the amount of sediment deposited in a water body.

segment - a subwatershed within a large river basin.

selective discharge - removal of water from a certain area or layer of the lake.

shoreland - land area within 1000 feet of the high water mark of a lake or 300 feet of a stream (as defined by State of Wisconsin).

shoreline - land area immediately adjacent to the lake water (within 100 feet).

spatial - differences over an area.

spring overturn - a natural mixing of thermally stratified water that commonly occurs during the early spring. The sequence of events leading to spring overturn includes (1) melting of ice cover, if present, (2) warming of surface water, (3) temperature change in surface water that produces convection currents from top to bottom, and (4) circulation of the total water volume by wind action. The overturn generally results in a uniformity of the physical and chemical properties of the water.

standard deviation (Std. Dev.) - a statistical term to describe the variability of the data around the mean (average); if the magnitude of the standard deviation is "small" relative to the mean, then most of the values are close to the mean in magnitude and the data has little variability (is relative uniform); if the standard deviation is large in magnitude relative to the mean, then the data is more variable.

standing crop - amount of matter present in a body of water at a particular time.

state impoundment - a body of standing water owned or leased and maintained by the Illinois Department of Conservation.

storage capacity - volume of water an impoundment can hold; often expressed in acre-feet, million gallons, and cubic meters.

stream - a body of water flowing in a channel or water course such as a river, creek or canal.

strip mine - water impoundment formed by the removal of coal from the ground by mechanical shovels.

submergent - an aquatic plant that lives and grows entirely below the surface of the water.

succession - in ecology, the progressive change of plant and animal life in an area.

summer stratification - during summer, the layering of the water in a lake or reservoir due to different densities as a function of temperature; the layers are the epilimnion (upper), metalimnion or thermocline (middle), and the hypolimnion (lower).

suspended sediment - the sediment that at any given time is maintained in suspension by current or as a colloid.

suspended solids - particulate material that at any given time is maintained in suspension by current or as a colloid; total suspended solids are all suspended particular material, volatile and non-volatile, organic and inorganic; volatile suspended solids is that suspended particulate material, generally organic in nature, which undergoes combustion at a temperature of 600°C.

suspension - a heterogenous mixture in which the particles of one substance are kept dispersed by agitation.

tabular - data presented in a table.

tailwaters - for a reservoir, stream area immediately downstream of the dam.

terrestrial - consisting of land, not water.

Tektronix - a type of desk top computer terminal.

thermal stratification - the layering of the water in a lake due to different densities as a function of temperature; the layers are the epilimnion (upper), metalimnion or thermocline (middle), and the hypolimnion (lower).

thermocline - metalimnion; the middle layer of water in a thermally stratified lake in which temperature decreases rapidly with increasing depth.

topography - the surface features of a region.

transparency - ability to allow light penetration and be seen through; clarity.

trophic state - the degree of eutrophication of a lake; the rate of primary biological production it is capable of supporting.

trophic state index - TSI; developed by Carlson (1977), an index number which can be calculated from Secchi disc transparency, chlorophyll a, or total phosphorus, where each major division represents a doubling of algal biomass; the higher the number the more eutrophic the lake.

turbid - cloudy, opaque, murky, dirty-looking; containing suspensoids (organic or inorganic) which interfere with light penetration.

turbidity - amount of scattering of light caused by material suspended in the water; materials causing a reduction in light penetration.

turnover - mixing period for a lake; period of time in which the entire lake volume is not thermally stratified and is totally mixed by wind action.

urban runoff - runoff from streets.

use impairment - that which damages or negatively impacts the present or potential use of a body of water.

vertebrates - larger animals which have a backbone or spinal cord.

visibility - clarity; transparency; ability to allow light penetration.

volatile - evaporating quickly; organic material which undergoes combustion at 600° C.

volume - storage capacity.

water quality - the suitability of the water for supporting various uses.

water quality management techniques - techniques to improve water quality.

water retention time or water renewal time - water residence time; period of time a mass of water remains in an impoundment.

watershed - drainage area; the land surface surrounding the lake which contributes water, via surface runoff, to the lake; the total or contributing watershed area is the total draining to the lake, including the lake surface area; the immediate or net watershed is the portion of the total watershed (free of lakes or sloughs) from which direct, unimpeded surficial runoff drains to the lake.

winter stratification - during winter, the layering of the water in a lake or reservoir due to different densities as a function of temperature; the layers are the epilimnion (upper), metalimnion or thermocline (middle), and the hypolimnion (lower).

zooplankton - animal portion of the community of suspended or floating organisms which drift passively with the water currents.

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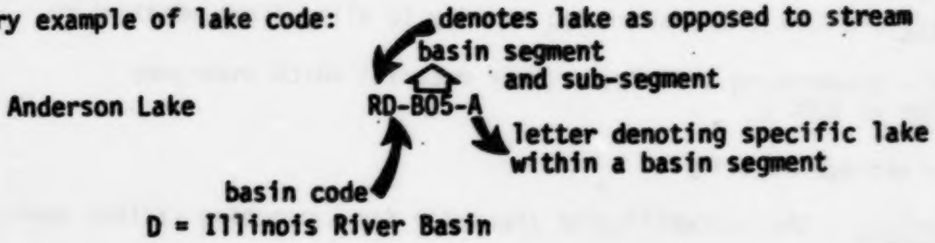
ABBREVIATIONS AND SYMBOLS

av - average
brn - brown
brnsh-grn - brownish-green
grn-brn - green-brown
grnsh-brn - greenish-brown
lt - light
max - maximum value
min - minimum value
mod - moderately
std. dev. - standard deviation
v - very

Explanatory example of lake code:


denotes lake as opposed to stream
basin segment
and sub-segment
Anderson Lake
RD-B05-A
letter denoting specific lake
within a basin segment
basin code
D = Illinois River Basin

*Definitions of items in sense used in text

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APPENDIX A.

Forms used in the 1981 Volunteer Lake Monitoring Program

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
VOLUNTEER LAKE MONITORING PROGRAM

PROGRAM OVERVIEW

The Volunteer Lake Monitoring Program is a service provided you by the Illinois EPA. It will supply you with information on the quality and problems of your lake, so that you may better understand the lake and make more informed decisions regarding its use, protection, and management. The information gathered in this program is not intended to be used in any enforcement action by the Agency.

You may adopt a lake which you wish to learn more about. Volunteers will be trained to take semimonthly Secchi disc transparency readings at three sites within each lake from May through October and report results to the Agency. Secchi discs and data forms will be furnished by the Agency. Resources permitting, water samples will be collected from public lakes by Agency personnel twice during the sampling season and analyzed for suspended solids, nutrient, and algae content. Data obtained will be analyzed in a report sent to participants each year at the end of the sampling.

OBJECTIVES

1. To determine the present water quality of those Illinois lakes which citizens are most concerned about.
2. To determine seasonal and long term water quality changes in the lakes.
3. To determine differences in quality within the lakes.
4. To compare the quality of each volunteer's lake with that of other lakes in the state.
5. To relate lake quality to meteorological conditions (e.g. rainfall, runoff, cloud cover).
6. To relate lake quality to lake morphology (area, depth, shape) and watershed characteristics.
7. To determine causes/sources of lake water quality problems.
8. To make citizens more aware of the above mentioned factors, as well as possible preventative/corrective actions.

WHAT IS A SECCHI DISC AND WHAT DOES IT TELL US?

A Secchi disc is a scientific tool for determining the transparency or clarity of the water. It is a weighted disc with alternate black and white quadrants. A rope is used to lower the disc into the water and measure the depth to which it is visible.

Measurements taken with a Secchi disc indicate the light penetration into a body of water. Generally, two to five times the Secchi disc depth is the euphotic (lighted) zone of the body of water. Here there is enough light available for plants to produce oxygen by photosynthesis. Thus, the euphotic zone is the region of the lake where there is enough oxygen to support fish and other aquatic life. Algae, zooplankton, water color, and especially sediment (silt, clay, and organic matter) are factors which interfere with light penetration. The Secchi disc readings for your lake will give an indication of the amount of usable habitat available for fish and other aquatic life, the lake productivity, and the general water quality, problems and causes.

MEASURING SECCHI DISC TRANSPARENCY AND TOTAL DEPTH

WHERE: Take readings from a boat at three sites in the lake, as specified by the Illinois EPA. (For reservoirs, Site 1 will generally be located near the dam, Site 2 at midlake or in a major arm, and Site 3 in the headwaters, a major arm, or tributary confluence. For glacial lakes, Site 1 will generally be located at the deepest spot in the lake).

DO NOT TAKE THE READINGS FROM SHORE OR FROM A DOCK.

Anchor the boat before measuring the transparency to ensure that the Secchi disc is observed straight down, instead of at an angle. Lower anchor carefully and allow boat to drift away from it slightly so that disturbance of bottom sediment will not affect readings.

Take readings at approximately the same spots each time.

Take Secchi readings on the shaded side of the boat. Measure total depth carefully on the opposite end of the boat from where Secchi readings are made so as to minimize bottom disturbance which may affect Secchi readings.

WHEN: Take readings semimonthly from May 1 through October 31: once between the first and fifteenth of each month and once between the sixteenth and thirty-first of each month. Try to make measurements between 10 a.m. and 4 p.m. on bright, calm days.

HOW: Lower the Secchi disc until it just goes out of sight and note the depth. Lower the disc further and then bring it up, noting where it comes into view again. Record the average of the two depths as the Secchi disc depth on the Secchi sheet. Record the Secchi depth to the nearest inch when the measurement is 2 feet or less; when the transparency is greater than 2 feet, record it to the nearest 1/4 foot.

Obtain the Total Depth measurement by using the Secchi disc as a sounding line. Lower the Secchi to the lake bottom and record the depth to the nearest 1/2 foot on the Secchi sheet.

To ensure that your readings are as accurate as possible, keep the Secchi disc clean.

DATA FORM COMPLETION

There will be 2 data sheets to complete and return to the Agency each time a lake is monitored: 1) the Secchi sheet, and 2) the Field Observations form. Examples of these forms are provided on the following pages.

Please print on all forms and use an ink pen. Fill in the Lake Name, County, Sampler's Name, Address, and Telephone Number, as well as the date on both forms.

On the Secchi form, fill in the blanks in Column 2. Record the time of sampling and circle if AM or PM. Measure the Secchi disc depth and record in the blank provided (to the nearest inch when the measurement is 2 feet or less; to the nearest 1/4 foot when transparency is greater than 2 feet). Circle if the measurement is in feet or inches. Measure the total depth and record it to the nearest 1/2 foot in the blank on the Secchi sheet.

Complete the Field Observations form each time the lake is sampled. On page 1, record the number that best describes lake conditions at the time sampled in the blank provided for each site on the lake. Note observations for color, sediment, algae, and weeds at the sample site as you are looking down into the water at the Secchi disc. Answer questions on page 2 for the lake as a whole.

Place both forms in stamped, self-addressed envelope provided and return to: IEPA Monitoring Unit, DWPC, 2200 Churchill Road, Springfield, Illinois 62706 as soon as possible after you complete them.

ILLINOIS EPA's LAKES PROGRAM

The Volunteer Lake Monitoring effort is part of the overall service program being developed by the Illinois EPA to assist lake managers in the protection and enhancement of their lakes. Past efforts have included an assessment of problems for 353 lakes, development of a Clean Lakes Strategy for Illinois, and sampling of 63 representative lakes in 1979. Reports summarizing these activities are available.

The Illinois EPA serves to administer the Federal Clean Lakes Program and apply for Federal funds for Phase 1 diagnostic/feasibility studies and Phase 2 implementation grants on behalf of managers of public lakes. The Agency will be undertaking a classification and prioritization of public lakes for funding under the Clean Lakes Program in 1981. The Agency also samples at least 15 representative lakes on a routine basis as part of its ambient water quality monitoring network.

If you would like further information on Illinois EPA's lakes program activities contact Donna Sefton; Lakes Program Coordinator; Planning Section; Division of Water Pollution Control; Illinois EPA; 2200 Churchill Road; Springfield, Illinois 62706; Telephone 217/782-3362 or a Public Participation Coordinator at an Illinois EPA regional office.

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SECCHI MONITORING
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
VOLUNTEER LAKE MONITORING PROGRAM

(Please print, using ink pen)

Lake Name:________________________ County:____________________

Sampler's Name(s):____

Sampler's Address:____

Date:____________________________ Telephone:__________________

COLUMN 1	COLUMN 2	COLUMN 3
RAMETER	VALUE (place value recorded in blank and circle appropriate units)	FOR AGENCY USE ONLY
TE #1 - NEAR DAM		COMPUTER CODED DATA STATION CODE S C . _ _ _ _ _ _ _ _ _ _ . 1-14
me	______________ AM or PM	YR. MO. DAY (15-20) HR. MIN. (21-25) . DEPTH OF SAMPLE D 0 0 1 . 26-30
tal Depth	______________ feet (to closest ½ foot)	Total Depth (feet) P 7 2 0 2 5 . _ _ _ _ _ . 31-43
cchi Disc Depth	______________ feet or ______________ inches	Secchi (inches) P 7 7 . _ _ _ _ _ . 44-53
TE #2 - MIDLAKE OR MAJOR ARM		STATION CODE S C . _ _ _ _ _ _ _ _ _ _ . 1-14
ime	______________ AM or PM	YR. MO. DAY (15-20) HR. MIN. (21-25) . DEPTH OF SAMPLE D 0 0 1 . 26-30
otal Depth	______________ feet (to closest ½ foot)	Total Depth (feet) P 7 2 0 2 5 . _ _ _ _ _ . 31-43
ecchi Disc Depth	______________ feet or ______________ inches	Secchi (inches) P 7 7 . _ _ _ _ _ . 44-53
ITE #3 - HEADWATERS, MAJOR ARM, or TRIBUTARY CONFLUENCE		STATION CODE S C . _ _ _ _ _ _ _ _ _ _ . 1-14
ime	______________ AM or PM	YR. MO. DAY (15-20) HR. MIN. (21-25) . DEPTH OF SAMPLE D 0 0 1 . 26-30
tal Depth	______________ feet (to closest ½ foot)	Total Depth (feet) P 7 2 0 2 5 . _ _ _ _ _ . 31-43
cchi Disc Depth	______________ feet or ______________ inches	Secchi (inches) P 7 7 . _ _ _ _ _ . 44-53

lace this form, along with Field Observations sheet in envelope provided and return to:
Monitoring Unit; DWPC; 2200 Churchill Rd.; Springfield, IL 62706.

FIELD OBSERVATIONS
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
VOLUNTEER LAKE MONITORING PROGRAM

(To be completed each date a
Secchi disc reading is made;
Please print, using ink pen)

LAKE NAME: ______________________ COUNTY: ______________________

DATE: ____________ SAMPLER'S NAME(S): ______________________ TELEPHONE: ____________

SAMPLER'S ADDRESS: ____

DIRECTIONS: Please place number(s) in blanks which best describe lake conditions at the time sampled. On page 1, record the number that best answers the particular question in the blank for each site on the lake. NOTE OBSERVATIONS FOR COLOR, SEDIMENT, ALGAE, AND WEEDS AT SAMPLE SITE AS YOU ARE LOOKING DOWN INTO THE WATER AT THE SECCHI DISC. On page 2, answer questions for the lake as a whole.

	SITE 1: DEEPEST SITE (NEAR DAM)	SITE 2: MIDLAKE OR MAJOR ARM	SITE 3: HEADWATERS, MAJOR ARM, OR TRIBOTARY CONFLUENCE
A. **COLOR**. The apparent color of the water is:	______	______	______
	______	______	______
B. **SEDIMENT**. The amount of sediment suspended in the water is:	______	______	______
C. **ALGAE**. The amount of suspended algae visible in the water is:	______	______	______

A. **COLOR**. The apparent color of the water is:

1. clear
2. light green
3. moderately green
4. very green
5. pea soup
6. greenish-brown (more green than brown)
7. green-brown (about equal green and brown)
8. brownish-green (more brown than green)
9. light brown
10. moderately brown
11. very brown
12. yellowish
13. other (specify)

B. **SEDIMENT**. The amount of sediment suspended in the water is:

1. minimal
2. slight
3. moderate
4. large

C. **ALGAE**. The amount of suspended algae visible in the water is:

1. minimal
2. slight
3. moderate
4. large

	SITE 1	SITE 2	SITE 3
D. **WEEDS AT SAMPLE SITE**. The amount of submergent or floating aquatic weeds at the sample site is:	______	______	______
E. **WEEDS NEAR SHORE**. The amount of aquatic weeds along the shore is:	______	______	______
F. **OTHER SUBSTANCES**. The following substances are present:	______	______	______
G. **ODOR**. The odor of the water is:	______	______	______

D. **WEEDS AT SAMPLE SITE**. The amount of submergent or floating aquatic weeds at the sample site is:

1. minimal
2. slight
3. moderate
4. large

E. **WEEDS NEAR SHORE**. The amount of aquatic weeds along the shore is:

1. minimal
2. slight
3. moderate
4. large

F. **OTHER SUBSTANCES**. The following substances are present:

1. none
2. dead fish
3. refuse
4. detritus
5. oil films
6. "grass clippings"
7. algal mats
8. algal colonies
9. duckweed
10. clumps of sediment
11. waterfowl
12. other (specify)

G. **ODOR**. The odor of the water is:

1. no odor
2. fishy
3. musty
4. rotten egg
5. septic
6. other (specify)

(CONTINUED ON BACK)

ILLINOIS EPA VOLUNTEER LAKE MONITORING PROGRAM - FIELD OBSERVATIONS, PAGE 2

LAKE NAME: ________________________________ COUNTY: ____________________ DATE: ____________

	PRESENT	PRECEEDING 24 HOURS
H. THE WEATHER		
Cloud Cover over lake	________	________
1. clear 2. hazy 3. few clouds 4. many clouds 5. overcast		
Precipitation at Lake	________	________
1. no rain 2. very light rain (<0.10 in.) 3. light rain(≥1.10 - ≤.50 in.) 4. moderate rain (>0.50 - ≤1.0 in.) 5. heavy rain (>1.0 in.)		
Waves	________	________
1. calm 2. ripple waves 3. small waves 4. moderate waves 5. white caps		
Air Temperature at Lake	________	________
1. cold (40°) 2. Cool (40°- 60°) 3. Warm (60°- 80°) 4. Hot (80°- 90°) 5. Very Hot (90°)		
Wind Direction (specify)	________	________

I. WATER LEVEL OF LAKE: The lake level is:

________ - ________

1. above normal (specify approx. number of inches)
2. normal
3. below normal (specify approx. number of inches)

J. RECREATIONAL USAGE

Recreational usage at time sampled
(place numbers for all applicable uses in blank)

____

1. none
2. fishing
3. swimming
4. power boating
5. waterskiing
6. row boating or canoeing
7. sailing
8. waterfowl hunting
9. camping
10. picknicking
11. other (specify) ____________________.

LAKE MANAGEMENT

Chemicals or other lake management techniques used since last sampling

Date ________________________________

Type, extent, and amount of treatment ____________

____

____

____

Reason for treatment ____________________

____

ADDITIONAL COMMENTS: ____________________

____

____

____

Place these forms, along with Secchi sheet in envelope provided and return to: IEPA, Monitoring Unit; DWPC; 2200 Churchill Road; Springfield, IL 62706, as soon as possible after you complete them.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
VOLUNTEER LAKE MONITORING PROGRAM
LAKE ASSESSMENT INFORMATION

Reported by: ______________________
Address: ______________________
____
Telephone: ______________________
Date: ______________________

Return to:
IEPA Monitoring Unit
Division of Water Pollution Control
2200 Churchill Road
Springfield, IL 62706

DIRECTIONS: Please print, using ink pen. Answer questions to the best of your ability. You may not be able to answer all of them. This information will greatly aid Monitoring Unit personnel in the analysis and interpretation of the water quality data collected for your lake, as well as in possibly providing technical assistance in the future. This information is not intended to be used in any enforcement action by the Agency.

I. GENERAL INFORMATION

LAKE NAME: ______________________ COUNTY: ______________
LAKE LOCATION: __________ MILES __________ OF __________
(number) (direction) (town)

OWNERSHIP: Name, address, and telephone number of lake owner and/or manager (specify)
____
____

LAKE SURFACE AREA (acres): __________ WATERSHED DRAINAGE AREA (acres): __________
MAXIMUM DEPTH (feet): __________ AVERAGE DEPTH (feet): __________
LAKE STORAGE CAPACITY (surface area x average depth): __________

NAME(S) OF INFLOWING STREAM(S): ______________________
NAME(S) OF OUTFLOWING STREAM(S): ______________________

LAKE TYPE (check appropriate type): Dammed stream ______ River backwater ______
Glacial ______ Coal strip-mine ______ Sand or gravel quarry ______
Other (specify) ______________________

YEAR CONSTRUCTED (if applicable): ______________________

INFORMATION SOURCE FROM WHICH YOU LEARNED ABOUT PROGRAM: Newspaper ______ Letter ______
Radio ______ Newsletter ______ Sign-up sheet ______ Word-of-Mouth ______
Illinois EPA personnel ______ Other (specify) ______________

II. USAGE

ACCESS:

Does the general public have access to the above body of water? Yes ______ No ______

Specify the policy for gaining access to the lake (e.g. unlimited access-free; unlimited access-fee charged; organization members only; invitation only) and describe access locations ______________________
____
____
____

LAKE NAME: ______________________ COUNTY: ______________

LAKE USAGE (check applicable blanks):

TYPE OF USE	AMOUNT OF USE					POTENTIAL FOR INCREASED USE
	NONE	LIGHT	MODERATE	HEAVY	VERY HEAVY	
Potable water supply						
Industrial water supply						
Agricultural water supply						
Conling water						
Recreation						
Fishing						
Swimming						
Power boating						
Waterskiing						
Row boating or canoeing						
Sailboating						
Camping						
Picnicking						
Waterfowl hunting						
Waterfowl observation						
Other (specify)						

Describe recreational facilities (e.g. beach, picnic areas, campground, boat launch, concessions, etc.) ______________________________

SHORELINE USAGE:

Estimate the percent of the immediate shoreline (lake frontage) which is: Urban (including streets) ________ Residential (including lawns) ________ Golf Courses ________ Pasture or grassland ________ Woodland ________ Row crops ________ Wetland ________ Other (specify) ______________________________

WATERSHED DRAINAGE AREA USAGE:

Estimate the percent of the drainage area devoted to the following uses: Urban ________ Residential ________ Golf Courses ________ Pasture or grassland ________ Woodland ________ Row crops ________ Wetland ________ Other (specify) ________

III. WATER QUALITY AND PROBLEMS

GENERAL WATER QUALITY:

In general, how would you describe the water quality of this lake?

Excellent ________ Good ________ Fair ________ Poor ________

FISHING:

How would you rate the fishing in this lake?

Excellent ________ Good ________ Fair ________ Poor ________

CONDITIONS:

To what degree does this lake exhibit the following water quality conditions?

TYPE OF WATER QUALITY CONDITION	EXTENT OF CONDITION			
	Minimal	Slight	Moderate	Large
Suspended Sediment (Turbidity)				
Deposition of Sediment (Sedimentation)				
Algal Blooms				
Aquatic Weeds				
Taste and/or Odor				
Water Level Fluctuation				
Fishkills				
Other (specify)				

ILLINOIS EPA VOLUNTEER LAKE MONITORING PROGRAM -- LAKE ASSESSMENT INFORMATION, PAGE 3

LAKE NAME: ______________________ COUNTY: ______________

Are there noticeable differences in turbidity or water quality in different portions of the lake? YES ________ NO ________

Comments on water quality ____

IV. CAUSES OF WATER QUALITY PROBLEMS

POTENTIAL POLLUTION SOURCES: (Check applicable sources)

Sewage treatment plant effluent ________ Industrial discharge ________ Urban storm drainage________ Septic tanks ________ Pasture or grassland runoff ________ Cropland runoff ________ Feedlot runoff ________ Construction site runoff ________ Fertilizer or pesticides from lawns/golf courses ________ Orchards ________ Forestry operations runoff ________ Mining ________ Waterfowl ________ Sediment in lake ________ Other (specify) ________

Comments: ____

V. LAKE MANAGEMENT

If any management techniques have been undertaken in the past or are being undertaken at the present time to improve the lake, please supply the date, type, and extent of the treatment, and the reason for the treatment.

DATE	TYPE AND EXTENT OF TREATMENT (Chemical/machine used, amount, coverage)	REASON FOR TREATMENT

ADDITIONAL COMMENTS: ____

VI. LAKE MAP

If a map of your lake is available and you haven't already sent it to Illinois EPA, please attach it to this form.

If a map of your lake is not available, please sketch an outline of the lake and attach it to this form. Please provide as much information as possible on lake depths and access areas.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
VOLUNTEER LAKE MONITORING PROGRAM
RELEASE OF ALL CLAIMS

The person signing below, hereinafter referred to as "Volunteer", hereby understands and acknowledges that:

1. Volunteer has agreed to sample a body of water located in the State of Illinois, as designated by the Illinois Environmental Protection Agency (hereinafter "Agency"), pursuant to the Agency's Volunteer Lake Monitoring Program (hereinafter "Program").

2. Volunteer is not an employee or agent of either the State of Illinois or the Agency while performing these activities.

3. Volunteer is responsible for providing transportation to and from the sampling locations(s), and is responsible for providing boats, motors, trailers and associated equipment necessary to perform this sampling.

4. Volunteer understands and assumes that during the course of sampling he/she may encounter hazards from the presence of other individuals using the body of water (boaters, water skiers, fishers, swimmers, etc.), from the presence of chemical solutions or other hazardous substances, or from natural occurences.

5. Volunteer understands that any individuals who may accompany him/her while sampling, or while traveling to and from the sampling location(s), have no connection with the State of Illinois, the Agency, or the Program unless such persons are Agency employees acting with the scope of his/her official duties.

6. Volunteer acknowledges that trespassing on private property is strictly prohibited, and shall not so trespass.

WAIVER

I, the below named person, being of sound mind and body, acting of my own free will, having read and understanding fully this document, and in consideration of being accepted as a Volunteer and other good and valuable consideration, do hereby waive any and all claims against the State of Illinois, the Agency, or any agent or employee of the State or the Agency acting lawfully and within the scope of his/her official duties arising during the course of my participation in the Program. This includes, but is not limited to, 1) claims by Volunteer, his estate, executor, administrator, heirs and assigns for wrongful death, personal injury or property damage arising during the course of sampling, or while traveling to and from the sampling location(s) and (2) claims for fines and other civil or criminal penalties or damages imposed upon Volunteer by a court of law arising in any way from Volunteer's participation in the program.

Lake Name(s): ______________________

County: ______________________

____
(Signature)

____
Name (Please Print)

____
Street Address

____
City and State

____
Telephone number

BH:bs/2420H/39-40

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
VOLUNTEER LAKE MONITORING PROGRAM
EQUIPMENT LOAN FORM

I acknowledge receipt of one (1) Secchi disc (#______________) and rope from the Illinois Environmental Protection Agency, and will use it in the Volunteer Lake Monitoring Program.

I understand that I may keep the Secchi disc and rope as long as I continue to participate in the program. I will return the Secchi disc and rope to the Agency within one month after I cease to participate in the program. The Agency will contact me early the following year to solicit my continuing participation in the program.

SIGNATURE OF PARTICIPANT ____

NAME (Please Print) ____

ADDRESS ____

____

TELEPHONE (Home) _______________ (Office) _________________________

DATE ____

LAKE NAME (S) _____________________________(County) _________________

APPENDIX B.

Participants in the 1981 Volunteer Lake Monitoring Program

TABLE 3. PARTICIPANTS IN ILLINOIS EPA VOLUNTEER LAKE MONITORING PROGRAM, 1981

CHICAGO REGION

Arbor Lake/DuPage Co.
Mr. Mike O'Brien
Ms. Patricia Suffredin
Westchester, IL

Briarwood Central Lake/DuPage Co.
Dr. Frank Lhotka
Oak Brook, IL

Lake Catherine/Lake Co.
Mr. Gary Berkebile
Schaumburg, IL

Channel Lake/Lake Co.
Mr. Gary Berkebile
Schaumburg, IL

Crystal Lake/McHenry Co.
Mr. Roger Naeseth
Mr. Michael Kane
Crystal Lake, IL

Dog Bone Lake/Lake Co.
Mrs. Pat Foersterling
Barrington, IL

Duck Lake/Lake Co.
Mr. Jack Kmiecik
Ingleside, IL

Gages Lake/Lake Co.
Mr. Howard Sturm
Grayslake, IL

Griswold Lake/Lake Co.
Mrs. Bonnie Hill
Mr. Robert Schultz
Mr. James Owens
McHenry, IL

Highland Lake/Lake Co.
Ms. Karen Kula
Mr. Harold Kirchhardt
Round Lake and Grayslake, IL

Indian Knoll Lake/Lake Co.
Ms. Pat Foersterling
Barrington, IL

Lake Inverness/Cook Co.
Mr. Al DeGenova
Inverness, IL

Island Lake/Lake Co.
Mr. Ronald Matthews
Island Lake, IL

Lake Killarney/McHenry Co.
Mr. James Touhy
Cary, IL 60013

Lake in the Hills/McHenry Co.
Ms. Jeanette Horner
Lake in the Hills, IL

Liberty Lake/Lake Co.
Mr. Michael Volino
Libertyville, IL

Lake Minear/Lake Co.
Mr. Ted Bond
Libertyville, IL

Potomoc Lake/Lake Co.
Mr. Curt Contreras
Mr. Ed Endicott
Lindenhurst, IL

Silver Lake/McHenry Co.
Mr. Bruce Wallace
Oakwood Hills and Cary, IL

Slocum Lake/Lake Co.
Ray and Jerie Tallman
McHenry, IL

Spring Lake/Lake Co.
Mr. Evans Mullins
Mr. Terry Richardson
Lincolnshire, IL

Sutton Place Lake/Lake Co.
Mr. Evans Mullins
Mr. Terry Richardson
Mr. Terry Williams
Lincolnshire, IL

TABLE 3. PARTICIPANTS IN ILLINOIS EPA VOLUNTEER LAKE MONITORING PROGRAM, 1981 (CONT.)

Tower Lake/Lake Co.
Mr. James Halborg
Barrington, IL

Valley Lake/Cook Co.
Mr. T. J. Westerberg
Inverness, IL

Wonder Lake/McHenry Co.
Mr. Jack Crawford
Ms. Joanne Heinly
Ms. Juanita Seabaugh
Wonder Lake, IL

NORTHWESTERN REGION

Apple Canyon Lake/Jo Daviess Co.
Mr. J. Scott Eversoll
Stockton, IL

Bass Lake/Lee Co.
Ms. Lisa Brooks
Sublette, IL

Black Oak Lake/Lee Co.
Ms. Lisa Brooks
Sublette, IL

Fyre Lake/Mercer Co.
Mr. Gary Stout
Sherrard, IL

Lake Galena/Jo Daviess Co.
Mr. Don Distler
Galena, IL

Lake George/Rock Island Co.
Mr. Mike Murrin
Illinois City, IL

Main Lake/Grundy Co.
Mr. Hillard Hainzinger, Jr.
Morris, IL

Spring Lake/Winnebago Co.
Dr. Louis Tisovec
Rockford, IL

Lake Summerset/Stephenson and Winnebago Co.
Mr. Dennis Bokemeier
Mr. Mike Ware
Davis, IL

Lake Sunset/Lee County
Ms. Lisa Brooks
Sublette, IL

Thunderbird Lake/Putnam Co.
Mr. James VanAlstin
Putnam, IL

Woodhaven Lake/Lee Co.
Ms. Lisa Brooks
Sublette, IL

CENTRAL REGION

Lake Bloomington/McLean Co.
Mr. Richard Carter
Mr. Murray Marks
Hudson and Bloomington, IL

Lake Canton/Fulton Co.
Mr. Raymond McKinney
Mr. Robin Shirley
Mr. Steve White
Canton, IL

Lake Carlyle/Clinton, Bond and Fayette Co.
Dr. D. J. Nack
Keyesport, IL

Lake Decatur/Macon Co.
Mr. Don Gibson
Mr. James Mayhugh
Mr. Brad Brown
Mr. Jake Watson
Mr. Greg Stengel
Mr. Charles Stone
Mr. Dan McMinn
Mr. Jeff Wilke
Mr. Jeff Hott
Decatur, IL

Lake Evergreen/McLean Co.
Kent and Janell Kloter
Goodfield, IL

Glen Shoals Lake/Montgomery Co.
Mr. David Booher
Hillsboro, IL

Greenfield City Lake/Greene Co.
Mr. James E. Moore
Greenfield, IL

TABLE 3. PARTICIPANTS IN ILLINOIS EPA VOLUNTEER LAKE MONITORING PROGRAM, 1981 (CONT.)

Lake Iroquois/Iroquois Co.
Mr. Kenneth M. Kulow
Loda, IL

Lake of the Woods/Champaign Co.
Mr. Bob Carlier
Mahomet, IL

Lake Jacksonville/Morgan Co.
Mr. John Little
Mr. Bill LaCount
Jacksonville, IL

LaHarpe City Reservoir/Hancock Co.
Mr. Robert Daniels
Mr. Jeff Sheffler
LaHarpe, IL

Lake Lou Yaeger/Montgomery Co.
Mr. Vernon Lee Hribar
Mr. Winfield Anderson
Litchfield, IL

Lake Mattoon/Coles, Cumberland, and Shelby Co.
Mr. David Bergman
Mattoon, IL

Northern Oaks Lake/Tazewell Co.
Mr. John Wald
Pekin, IL

Lake Oakland/Coles Co.
Mr. Dale Hanner
Mr. Randy Duzan
Mr. Ken McClain
Mr. Henry McClain
Oakland, IL

Old Gillespie Lake/Macoupin Co.
Mr. Ray Fritz
Gillespie, IL

Paradise Lake/Coles Co.
Mr. Dave Bergman
Mattoon, IL

Paris East Lake/Edgar Co.
Mr. Warren Brown
Paris, IL

Paris West Lake/Edgar Co.
Mr. Warren Brown
Paris, IL

Lake Petersburg/Menard Co.
Mr. Robert W. Eisenhart
Petersburg, IL

Pohlman Slough/Calhoun Co.
Messrs. Robert and Kenny Freeman
Godfrey, IL

Royal Lake/Calhoun Co.
Messrs. Robert and Kenny Freeman
Godfrey, IL

Spring Lake/McDonough Co.
Mr. Meredith Shryack
Macomb, IL

Lake Springfield/Sangamon Co.
Mr. Tim Hillary
Ms. Mary Ann Miller
Ms. Shelley Keeling
Chatham and Springfield, IL

Staunton Sportsman Club Lake/Macoupin Co.
Mr. Ronald Heigert
Staunton, IL

Swan Lake/Calhoun Co.
Messrs. Robert and Kenny Freeman
Godfrey, IL

Lake Taylorville/Christian Co.
Mr. Joe Marucco
Mr. Bruce McKinney
Taylorville Water Department
Taylorville, IL

Waverly City Lake/Morgan Co.
Mr. Maurice Mitchell
Mr. James Watts
Mr. John Bostic
Mr. Stanley Eyer
Waverly, IL

TABLE 3. PARTICIPANTS IN ILLINOIS EPA VOLUNTEER LAKE MONITORING PROGRAM, 1981 (CONT.)

SOUTHERN REGION

Altamont New Reservoir/Effingham Co.
Mr. Steve Evans
Altamont, IL

Ashley Lake/Washington Co.
Mr. Ronald Schaefer
Ashley, IL

Baldwin Lake/Randolph and St. Clair Co.
Mr. Ray Martin
Freeburg, IL

Benton Lake/Franklin Co.
Mr. Leonard Hopkins
Benton, IL

Borah Lake/Richland Co.
Mr. Arthur Omland
Olney, IL

Campus Lake/Jackson Co.
Ms. Cindy Nolan
Ms. Margaret Susan O'Leary
Mr. Ken Wyatt
Ms. Donna Cottam
Mr. Dave Carney
Mr. Chris Jensen
Mr. Mike Lossau
Mr. Mike Salmond
Ms. Nicole Blase
Ms. Denise Swanson
Carbondale, IL

East Fork Lake/Richland Co.
Mr. Arthur Omland
Olney, IL

Lake of Egypt/Johnson and Williamson Co.
Mr. W. Dale Shadowens
Mr. Jimmy Robb
Goreville and Marion, IL

Highland Silver Lake/Madison Co.
Mr. Cyril Frey
Mr. Ray Werner
Mr. Donald Hundsdorfer
Highland, IL

Lake Kinkaid/Jackson Co.
Mr. Robert Chapman
Mr. Gilbert Lee
Mr. John Jesse
Ms. Gayle Whittenberg
Mr. Robert Saupe
Mr. Fred Boucher
Campbell Hill, Murphysboro and Goreville, IL

Little Grassy Lake, Williamson Co.
Mr. Jerry Culen
Mr. Jim Jordan
Carbondale, IL

Omaha Lake/Gallatin Co.
Mr. Robert Langley
Omaha, IL

Pinckneyville City Reservoir/Perry Co.
Mr. Don Wilkin
Mr. Bob Logan
Pinckneyville, IL

Raccoon Lake/Marion Co.
Mr. Kenneth Oestreich
Mr. Gerald Sanders
Mr. Arthur Yoos
Centralia, IL

Salem Reservoir/Marion Co.
Mr. Bill Dennis
Mr. Jack Hendrick
Mr. Leroy Phillips
Mr. Robert Thomas
Salem and Alma, IL

Lake Sara/Effingham Co.
Mr. Terry Awalt
Mr. Mike Vonderheide
Effingham, IL

Spring Arbor Lake/Jackson Co.
Dr. David R. Derge
Carbondale, IL

Stanberry Lake/Fayette Co.
Mr. Walter Horsthemke
Vandalia, IL

Thompson Fishing Club Lake/Jackson Co.
Mr. A. Frank Bridges
Carbondale, IL

Tower Lake/Madison Co.
Ms. Ann Schonlau
Mr. Michael Oexner
Edwardsville, IL

Vernor Lake/Richland Co.
Mr. Arthur Omland
Olney, IL

Vienna Correctional Center Lake/Johnson Co.
Mr. Otto R. Roethe
Mr. Davis C. Prewitt
Vienna, IL

APPENDIX C.

Description of monitoring sites, 1981 Volunteer Lake Monitoring Program

TABLE 5. VOLUNTEER LAKE MONITORING PROGRAM, 1981

LAKE CODE	MAP CODE	LAKE NAME	COUNTY	SITE	LATITUDE			LONGITUDE			DESCRIPTION	PARAMETERS*
Ohio River Basin												
RA-A01-S	RAS	Omaha	Gallatin	1	37	55	47	88	21	33	Near dam	N (81), 0
				2	37	55	47	88	21	28	Mid lake	
				3	37	55	46	88	21	25	1000' N of dam	
RA-A03-L	RAL	Lake of Egypt	Williamson	1	37	37	15	88	56	36	Near dam	N (80-81),0
				2	39	35	42	88	55	09	Co. Line, mid lake	
				3	37	35	06	88	52	90	Far E. finger btwn 1st 2 pts	
RA-B03-T	RAT	Vienna Cor Ctr	Johnson	1	37	24	46	88	45	37	not available	0
				2	37	24	41	88	46	05	Not available	
				3	37	24	35	88	46	24	Not available	
Wabash River Basin												
RB-A04-L	RBL	Paris Twin	Edgar	1	39	38	27	87	41	08	E.L.; road dam & E. arm	(81)
				2	39	38	02	87	40	47	EL.L: old dam & boat dock	
				3	39	38	12	87	41	42	W.L.; W. side Ill. Rt. 1	
				4	39	38	20	87	41	54	100 Ft. S.E. of island	
				5	39	38	16	87	42	12	400 Ft. E. of Penn. Cen. R.R. Br	
				6	39	38	22	87	40	38		
RB-A05-P	RBP	Oakland	Coles	1	39	01	55	88	42	52	Near dam	N (81), 0
				2	39	02	13	88	43	05	Mid lake	
				3	39	02	25	88	43	17	North arm at head	
Little Wabash River Basin												
RC-A09-A	RCA	Olney Old (Vernor)	Richland	1	38	45	46	88	06	09	Near dam	N (81), 0
				2	38	45	51	88	05	59	Midlake	
				3	38	45	55	88	05	50	Hdwtrs, 500' S. of Ill 130 Br.	
RC-A09-B	RCB	Olney New (Borah)	Richland	1	38	46	30	88	04	02	Near dam	N (81), 0
				2	38	46	55	88	03	44	Middle N. arm	
				3	38	46	45	88	03	27	Middle SE arm	
RC-A09-C	RCC	Olney East Fork	Richland	1	38	45	43	88	04	34	Near dam	N (81), 0
				2	38	45	32	88	04	00	Midlake	
				3	38	45	37	88	02	32	E. end, W. of Br.	
RC-A09-E	RCE	Sara	Effingham	1	39	07	38	88	37	10	Near dam	N (81), 0
				2	39	08	20	88	38	52	Midlake & 1st N. arm	
				3	39	08	48	88	38	52	Mouth far W. trib. confl.	

TABLE 5. VOLUNTEER LAKE MONITORING PROGRAM, 1981 (Cont.)

LAKE CODE	MAP CODE	LAKE NAME	COUNTY	SITE	LATITUDE			LONGITUDE			DESCRIPTION	PARAMETERS*
RC-A09-F	RCF	Mattoon	Coles	1	39	20	00	88	28	50	Near dam & pumphouse	N (81), O
				2	39	21	28	88	27	50	1150' NE Br. by boat ramp	
				3	39	22	16	88	27	50	Hdwtrs 5750' N. Site 2	
RC-A09-G	RCG	Paradise	Coles	1	39	24	47	88	26	27	Near dam	N (81), O
				2	39	25	09	88	25	57	NE of dam, by picnic area	
				3	39	25	09	88	25	43	Far NE tip	
RC-A09-J	RCJ	Altamont New	Effingham	1	39	01	55	88	42	52	Near dam	N (81), O
				2	39	02	13	88	43	06	Center of lake	
				3	39	02	25	88	43	17	Headwaters	
Illinois River Basin												
SD-A02-T	SDT	Old Gillespie	Macoupin	1	39	08	46	89	51	49	Near dam	N (81), O
				2	39	08	42	89	51	26	NE arm, out from second cove	
				3	39	08	30	89	51	35	SE arm, mid lake at second major cove	
SD-A03-A	SDA	Evergreen	McLean	1	40	38	55	89	01	50	300' from center of dam	N (81), O
				2	40	38	35	89	02	06	Mid Ch. 1.5 mi. N. of access	
				3	40	38	03	89	03	09	Btwn. lg. & sm. Is., near access	
RD-A03-O	RDO	Bloomington	McLean	1	40	39	34	88	56	00	Near dam	N (81), O
				2	40	39	01	88	55	45	Midlake at mouth SE arm	
				3	40	38	23	88	55	18	Hdwtrs near Boy Scout Camp	
RD-A05-R	RDR	Spring	McDonough	1	40	30	20	90	43	03	Near dam	N (81), O
				2	40	30	31	90	43	24	W. of Site 1, mouth 2nd N. arm	
				3	40	30	37	90	44	10	W. end L, 3000' W. Site 2	
RD-A05ZE	RDZE	LaHarpe	Hancock	1	40	35	25	90	58	02	Middle of E. half of lake	N (81), O
				2	40	35	25	90	57	58	Middle of W. half of lake	
				3								
RD-A06ZF	RDZF	Greenfield	Green	1	39	20	00	90	11	36	Near dam	N (81), O
				2	39	20	02	90	11	35	Middle of west arm near ramp	
				3	39	20	04	90	11	30	East arm, half way from headwaters	
UD-B06-A	UDA	Polhman	Calhoun	1	38	57	41	90	29	31	Not available	O
				2	38	57	28	90	29	45	Not available	O
				3	38	57	17	90	29	53	Not available	O
SD-B02-M	SDM	Swan	Calhoun	1	38	56	41	90	31	47	Near dam	O
				2	39	42	40	90	33	45	Midlake out from N. bay	
				3	39	42	31	90	34	32	Headwaters	

TABLE 5. VOLUNTEER LAKE MONITORING PROGRAM, 1981 (Cont.)

LAKE CODE	MAP CODE	LAKE NAME	COUNTY	SITE	LATITUDE			LONGITUDE			DESCRIPTION	PARAMETERS*
SD-B02-O	SDO	Royal	Calhoun	1	38	56	06	90	39	19	Near dam	O
				2	38	56	18	90	30	03	Midlake, 3500' NE Site 1	
				3	38	56	29	90	30	47	750' S Br. to Rt. 10	
SD-B03-Q	SDQ	Thunderbird	Putnam	1	Not available						Not available	O
				2	Not available						Not available	
				3	Not available						Not available	
RD-B05-D	RDD	Canton	Fulton	1	40	33	52	89	58	21	Near dam	N (81), O
				2	40	34	20	89	58	48	75 mi. SE new dock	
				3	40	35	31	89	59	17	Pt. off new dock	
SD-B05-W	SDW	Northern Oaks	Tazewell	1	40	35	32	89	33	13	Not available	O
				2	40	35	20	89	33	05	Not available	
				3	40	35	24	89	32	58	Not available	
SD-B06-C	SDC	Waverly	Morgan	1	39	36	03	90	00	33	Near dam control tower	N (81), O
				2	39	36	15	90	00	40	At conference of major trib.	
				3	39	36	21	90	00	56	Headwaters	
RD-B06-I	RDI	Jacksonville	Morgan	1	39	40	21	90	12	44	Near dam	N (81), O
				2	39	40	06	90	11	02	Midlake, near boat launch	
				3	39	40	32	90	12	01	Headwaters - trib. confl.	
Sangamon River Basin												
RE-A04-C	REC	Taylorville	Christian	1	39	31	46	89	15	21	Near dam	N (81), O
				2	39	30	20	89	15	20	Midlake; 8000' S. Site 1	
				3	39	29	05	89	15	26	S. end 2000' N. Co. Rd Br.	
RE-A05-F	REF	Springfield	Sangamon	1	39	45	22	89	35	37	Near dam; over old cr. channel	N (80-81), O
				2	39	42	43	89	36	13	Midlake; btwn Lindsay & ICRR Br.	
				3	39	41	40	89	38	16	1700' W. ICRR Br.	
RE-B01-G	REG	Lake of the Woods	Champaign	1	40	12	02	88	22	54	Near spillway	O
				2	40	11	57	88	23	49	Mouth of South finger	
				3	40	12	01	88	22	41	Across from beach	
RE-B02-A	REA	Decatur	Macon	1	39	49	28	88	57	09	Near dam	N (80-81), O
				2	39	50	33	88	53	47	1 mi. NE US 36 Br.	
				3	39	52	28	88	51	59	1 mi. NE Wabash RR at SE Boat ramp	
RE-B06-L	REL	Petersburg	Menard	1	39	59	22	89	50	56	Not available	O
				2	39	59	12	89	51	11	Not available	
				3	39	59	08	89	51	43	Not available	
				4	39	59	10	89	51	53	Not available	

TABLE 5. VOLUNTEER LAKE MONITORING PROGRAM, 1981 (Cont.)

LAKE CODE	MAP CODE	LAKE NAME	COUNTY	SITE	LATITUDE			LONGITUDE			DESCRIPTION	PARAMETERS*
Kankakee River Basin												
RF-A01-A	RFA	Iroquois	Iroquois	1	40	32	22	88	05	41	Not available	0
				2	40	32	11	88	05	41	Not available	
				3	40	31	51	88	05	49	Not available	
Des Plaines River Basin												
RG-A01ZT	RGZT	Spring	Lake	1	Not available						Not available	0
				2	Not available						Not available	
				3	Not available						Not available	
RG-A02N	RGN	Briarwood	DuPage	1	41	50	19	87	57	47	Not available	0
				2	41	50	19	87	57	37	Not available	
				3	41	50	19	87	57	37	Not available	
RG-A08ZI	RGZI	Arbor	DuPage	1	41	47	48	88	03	51	Not available	0
				2	41	47	44	88	03	56	Not available	
				3	41	47	53	88	03	49	Not available	
RG-B01-I	RGI	Gages	Lake	1	42	21	02	87	59	48	1320 ft E of Rt. 45 Ctr of lake	0
				2	42	21	09	88	00	00	880 ft SSE from boat shop	
				3	42	21	54	88	08	05	1650 ft SE of site 1	
RG-B01-P	RGP	Minear	Lake	1	42	18	18	87	57	35	Not available	0
				2	42	18	13	87	57	26	Not available	
				3	42	18	10	87	57	19	Not available	
RG-B02-T	RGT	Liberty	Lake	1	42	18	35	87	57	58	Not available	0
				2	42	18	30	87	57	56	Not available	
				3	42	18	41	87	58	02	Not available	
RG-B02 K	RGZK	Potomac	Lake	1	42	25	53	88	01	33	Not available	0
				2	42	25	56	88	01	32	Not available	
				3	42	26	03	88	01	32	Not available	
RG-B02ZM	RGZM	Valley	Cook	1	42	05	20	88	04	43	Not available	0
				2	42	05	20	88	04	47	Not available	
				3	42	04	48	88	05	23	Not available	
RG-B02ZN	RGZN	Inver (Pheasant)	Cook	1	42	05	36	88	05	08	Not available	0
				2	42	05	39	88	05	06	Not available	
				3	42	05	40	88	05	03	Not available	

TABLE 5. VOLUNTEER LAKE MONITORING PROGRAM, 1981 (Cont.)

LAKE CODE	MAP CODE	LAKE NAME	COUNTY	SITE	LATITUDE	LONGITUDE	DESCRIPTION	PARAMETERS*
RG-B02ZM	RGZM	Valley	Cook	1	42 05 20	88 04 43	Not available	0
				2	42 05 20	88 04 47	Not available	
				3	42 04 48	88 05 23	Not available	
RG-B02ZN	RGZN	Inver (Pheasant)	Cook	1	42 05 36	88 05 08	Not available	0
				2	42 05 39	88 05 06	Not available	
				3	42 05 40	88 05 03	Not available	
Chicago and Calumet River Basin								
RH-A01-N	RHN	Sutton Place	Lake	1	Not available		Not available	0
				2	Not available		Not available	
				3	Not available		Not available	
Mississippi River South Central Basin								
RJ-A02-O	RJO	Tower	Madison	1	38 48 18	90 00 12	Near dam	N (81), 0
				2	38 48 05	89 55 55	Middle E. arm	
				3	38 48 01	90 00 05	Middle S. arm	
RJ-A02-P	RJP	Staunton S.C.	Macoupin	1	39 02 33	89 46 45	Not available	0
				2	39 02 52	89 46 50	Not available	
				3	39 03 05	89 46 41	Not available	
Mississippi River North Central Basin								
RL-B01-A	RLA	George	Rock Island	1	41 25 58	90 49 57	Near dam	N (81), 0
				2	41 25 38	90 49 47	1320' S. Launch Ramp	
				3	41 25 25	90 48 56	Center of SE tip of lake	
RL-B01-H	RLH	Fyre	Mercer	1	41 17 49	90 29 18	Not available	0
				2	41 18 05	90 29 31	Not available	
				3	41 18 34	90 29 31	Not available	
Mississippi River North Basin								
RM-A01-J	RMJ	Apple River Canyon	JoDaviess	1	42 25 02	90 09 51	Not available	0
				2	42 25 32	90 09 55	Not available	
				3	42 26 40	90 10 17	Not available	

TABLE 5. VOLUNTEER LAKE MONITORING PROGRAM, 1981 (Cont.)

LAKE CODE	MAP CODE	LAKE NAME	COUNTY	SITE	LATITUDE			LONGITUDE			DESCRIPTION	PARAMETERS*
Big Muddy River Basin												
RN-A04-H	RNH	Pinckneyville	Perry	1	38	05	48	89	23	48	Near dam	N (81), O
				2	38	06	15	89	24	08	Midlake; mouth 2 N. arms	
				3	38	06	27	89	24	33	Headwaters; mouth of trib. confl.	
RN-A06-K	RNK	Little Grassy	Williamson	1	37	38	38	89	08	16	Near dam	N (81), O
				2	37	37	43	89	08	41	Mid lake, before arms; 2 bays	
				3	37	37	07	89	07	54	SE arm, first large bay	
RN-A07ZG	RNZG	Spring Arbor	Jackson	1	37	39	01	89	10	08	Not available	O
				2	37	38	28	89	10	05	Not available	
				3	37	38	28	89	10	16	Not available	
RN-A07ZH	RNZH	Campus	Jackson	1	37	42	32	89	13	23	Near dam	N (81), O
				2	37	42	33	89	13	35	Midlake confl. W. arm	
				3	37	42	41	89	13	36	Middle N. arm	
RN-A08-C	RNC	Kinkaid	Jackson	1	37	46	25	89	22	50	Near dam	N (81), O
				2	37	46	42	89	22	48	W. ext., near mouth S. arm	
				3	37	46	55	89	22	59	Far W. extension before 90° angle	
RN-B01-O	RND	Benton	Franklin	1	38	03	18	88	54	57	At dam	N (81), O
				2	38	03	23	88	55	01	East arm	
				3	38	03	17	88	54	41	North arm, mid lake	
RN-B01ZB	RNZB	Ashley	Washington	1	38	20	45	89	10	46	Near dam	N (81), O
				2	38	20	58	89	10	48	Mid lake at first cove of N arm	
				3	38	20	44	89	10	54	Mid lake, west arm	
RN-B03ZJ	RNZJ	Thompson Fishing Club	Jackson	1	37	44	40	89	15	22	Not available	O
				2	37	44	40	89	15	13	Not available	
				3	37	44	37	89	15	16	Not available	
Kaskaskia River Basin												
RO-A01-L	ROL	Glen Shoals (Hillsboro New)	Montgomery	1	39	10	50	89	29	50	Near dam	N (81), O
				2	39	12	36	89	27	53	Confl. of Little Cr. arm w/main body	
				3	39	14	07	89	27	57	Headwaters trib. confl.	
RO-A01-N	RON	Lou Yaeger	Montgomery	1	39	11	19	89	36	02	Near dam	N (81), O
				2	39	12	42	89	36	31	Midlake before sm. island	
				3	39	14	04	89	35	43	2 mi. NE of sm. island	

TABLE 5. VOLUNTEER LAKE MONITORING PROGRAM, 1981 (Cont.)

LAKE CODE	MAP CODE	LAKE NAME	COUNTY	SITE	LATITUDE			LONGITUDE			DESCRIPTION	PARAMETERS*
RO-A02-K	ROK	Raccoon	Marion	1	38	32	34	89	06	00	Near dam btwn. pt. & 1st house	N (80-81), O
				2	38	32	36	89	05	07	Midlake btwn. white house & pt.	
				3	38	32	23	89	04	10	Mouth far E. arm	
RO-A02-R	ROR	Salem	Marion	1	38	38	38	89	56	45	Near dam	N (81), O
				2	38	38	56	89	56	44	Mid lake, S of bridge	
				3	38	38	07	89	56	48	Headwaters, N of bridge	
RO-A04ZA	ROZA	Highland Silver	Madison	1	38	46	07	89	41	55	Near Spillway	N (80-81), O
				2	38	47	39	89	41	18	N. of Br. near peninsula	
				3	38	48	53	89	40	22	Far N. tip of lake	
				4	38	47	08	89	41	46	West Finger	
				5	38	47	13	89	41	48	West Finger	
				6	38	47	16	89	41	48	Not available	
				7	38	47	24	89	41	58	Not available	
				8	38	47	31	89	41	55	Not available	
				9	38	48	125	89	41	02	Not available	
				10	38	47	21	89	42	24	Not available	
RO-B03ZE	ROZE	Stanberry	Fayette	1	38	56	31	89	02	19	Not available	O
				2	38	56	32	89	02	15	Not available	
				3	38	56	33	89	02	08	Not available	
RO-B04-A	ROA	Carlyle	Clinton	1	38	42	20	89	18	23	Not available	O
				2	38	43	23	89	18	34	Not available	
				3	38	45	08	89	15	38	Not available	
Rock River Basin												
RP-A06-I	RPI	Summerset	Stephenson	1	42	26	54	89	23	05	Not available	O
				2	42	27	07	89	23	44	Not available	
				3	42	27	20	89	24	23	Not available	
RO-B05-W	ROW	Baldwin	Randolph, St. Clair	1	38	12	36	89	52	37	Near dam	N, O
				2	38	12	05	89	52	07	Center of section S. of peninsula	
				3	38	13	46	89	52	03	Center of section N. of peninsula	
Rock River Basin												
RP-A06-I	RPI	Summerset	Stephenson	1	42	26	54	89	23	05	Not available	O
				2	42	27	07	89	23	44	Not available	
				3	42	27	20	89	24	23	Not available	

TABLE 5. VOLUNTEER LAKE MONITORING PROGRAM, 1981 (Cont.)

LAKE CODE	MAP CODE	LAKE NAME	COUNTY	SITE	LATITUDE			LONGITUDE			DESCRIPTION	PARAMETERS*
RP-A06-J	RPJ	Bass	Lee	1	41	39	04	89	15	05	Not available	0
				2	41	39	01	89	15	03	Not available	
				3	41	38	58	89	16	58	Not available	
RP-A06-K	RPK	Black Oak	Lee	1	Not available						Not available	0
				2	Not available						Not available	
				3	Not available						Not available	
RP-A06-L	RPL	Sunset	Lee	1	41	39	20	89	18	20	Not available	0
				2	41	39	18	89	18	24	Not available	
				3	41	39	15	89	18	11	Not available	
RP-A06-M	RPM	Woodhaven	Lee	1	41	39	00	89	17	49	Not available	0
				2	41	39	05	89	17	45	Not available	
				3	41	38	58	89	17	43	Not available	
RP-B02-N	RPN	Spring	Winnebago	1	42	18	18	89	00	30	Not available	
				2	42	18	21	89	00	26	Not available	
				3	42	18	17	89	00	19	Not available	
RP-B03-E	RPE	Crystal	Lake	1	42	14	06	88	21	19	2800' W. of E. Beach	N (81), 0
				2	42	14	06	88	21	43	200' before sm. peninsula	
				3	42	14	00	88	20	51	800' W. of beach at E. end L	
Fox River Basin												
RT-B01-D	RTD	Catherine	Lake	1	42	29	09	88	07	42	Not available	N (81), 0
				2	42	29	57	88	07	44	Not available	
				3	42	29	50	88	07	42	Not available	
RT-B01-I	RTI	Channel	Lake	1	42	29	11	88	08	15	980' W. of S. end of gravel bar	N (81), 0
				2	42	28	49	88	08	25	1470' S. of Site 1	
				3	42	28	32	88	08	47	980' N. of Rt. 173 Br.	
RT-B01ZC	RTZC	Wonder	McHenry	1	42	22	30	88	21	17	200 yds S of dam mid channel	0
				2	42	23	08	88	21	09	Near Marina Middle of finger	
				3	42	24	00	88	20	55	1 mile south of Site 2	
RT-B01ZF	RTZF	Tower	Lake	1	42	14	02	88	09	21	Not available	0
				2	42	13	45	88	09	15	Not available	
				3	42	13	43	88	09	59	Not available	
RT-B01ZG	RTZG	Duck	Lake	1	42	22	34	88	07	17	Not available	0
				2	42	22	27	88	07	18	Not available	
				3	42	22	50	88	07	23	Not available	

TABLE 5. VOLUNTEER LAKE MONITORING PROGRAM, 1981 (Cont.)

LAKE CODE	MAP CODE	LAKE NAME	COUNTY	SITE	LATITUDE	LONGITUDE	DESCRIPTION	PARAMETERS*
RT-B01ZG	RTZG	Duck	Lake	1	42 22 34	88 07 17	Not available	0
				2	42 22 27	88 07 18	Not available	
				3	42 22 50	88 07 23	Not available	
RT-B01ZP	RTZP	Highland	Lake	1	42 21 40	88 03 42	Not available	0
				2	42 21 37	88 03 32	Not available	
				3	42 21 38	88 03 53	Not available	
VT-B02-B	VTB	Dogbone	Lake	1	42 13 42	88 07 06	Not available	0
				2	42 13 42	88 07 14	Not available	
				3	42 13 41	88 07 25	Not available	
VT-B02-E	VTE	Indian Knoll	Lake	1	42 13 42	88 07 06	Not available	0
				2	42 13 42	88 07 14	Not available	
				3	42 13 41	88 07 25	Not available	
RT-B02-P	RTP	Slocum	Lake	1	42 15 37	88 11 17	Not available	0
				2	42 15 42	88 11 00	Not available	
				3	42 15 32	88 11 37	Not available	
RT-B02-W	RTW	Silver	McHenry	1	42 14 36	88 14 57	Not available	0
				2	42 14 50	88 14 47	Not available	
				3	42 14 42	88 14 49	Not available	
RT-B02-Y	RTY	Griswold	McHenry	1	42 17 20	88 13 02	400 yds SW Beach midlake	N (81), 0
				2	42 17 24	88 12 50	200 yds S of Beach	
				3	42 17 15	88 13 16	100 yds from Fox outlet	
RT-B02ZI	RTI	Island	Lake	1	42 16 31	88 12 03	Not available	0
				2	42 16 37	88 12 47	Not available	
				3	42 16 49	88 12 54	Not available	
RT-B02ZV	RTZV	Killarney	McHenry	1	42 14 21	88 15 22	Not available	0
				2	42 14 22	88 15 32	Not available	
				3	42 14 17	88 15 33	Not available	
RT-B03ZZ	RTZZ	Lake in the Hills	McHenry	1	42 10 49	88 19 07	Not available	0
				2	42 11 00	88 19 14	Not available	
				3	42 10 49	88 19 35	Not available	

*

N. Ambient Lakes (Semi-annual, May-June and August-September) 1980-1981: Turbidity (00076), 000 (00335), total suspended solids (00530), volatile suspended solids (00535), ammonia nitrogen (00610), Kjeldahl nitrogen (00625), nitrite-nitrate nitrogen (00630), total phosphorus (00665), dissolved phosphorus (00666), total depth (72025), Secchi (00077), pH (00400), conductivity (00094), phenothalein alkalinity (00415), total alkalinity (00410), air temperature (00020), cloud cover, % (00032), wind velocity (00035), wind direction (00036), precipitation (00045), chlorophyll a (corrected) (32211), chlorophyll a (uncorrected) (32210), chlorophyll b (32212), chlorophyll c (32214), pheophytin a (32218), profiles of: water temperature (00010), and dissolved oxygen (00299); 1980 only: chloride (00940), fecal coliforms (31616).

O. Volunteer Lakes (Semi-monthly, May-October): Secchi (00077), total depth (72025).

JL:bls/4194C,spl-10

APPENDIX D.

Evaluation of data returns, 1981 Volunteer Lake Monitoring Program

TABLE 6. INDIVIDUAL LAKE DATA RETURNS, VOLUNTEER LAKE MONITORING PROGRAM, 1981.

Lake Name	County	No. of Time Periods Sampled	% of Time Periods Sampled	Total No. of Samples	Time Periods Sampled											
					1	2	3	4	5	6	7	8	9	10	11	12
					May		June		July		Aug.		Sept.		Oct.	
Chicago																
Arbor	DuPage	4	33.3	5	X	X	X		X							
Barrington	Lake	0	0.0	0												
Briarwood	DuPage	11	91.7	11	X	X		X	X	X	X	X	X	X	X	X
Catherine	Lake	6	50.0	6	X	X	X	X			X	X				
Channel	Lake	6	50.0	6	X	X	X	X			X	X				
Crystal	McHenry	9	75.0	9	X	X		X	X	X	X	X	X	X		
Defiance	McHenry	0	0.0	0												
Dog Bone	Lake	3	25.0	5	X	X				X						
Duck	Lake	5	41.7	5	X	X	X	X		X						
East Loon	Lake	0	0.0	0												
Gages	Lake	6	50.0	8	X	X		X		X	X		X			
Griswold	McHenry	12	100.0	20	X	X	X	X	X	X	X	X	X	X	X	X
Highland	Lake	11	91.7	17	X	X		X	X	X	X	X	X	X	X	X
Indian Knoll	Lake	7	58.3	9	X	X			X	X		X	X			X
Inver (Pheasant)	Lake	6	50.0	6	X	X		X	X		X					
Island	Lake	1	8.3	1												
Killarney	McHenry	2	16.7	2		X	X									
Lake-in-the-Hills	McHenry	7	58.3	7						X	X	X	X	X	X	X
Lake Shore Estates	Cook	0	0.0	0												
Liberty	Lake	4	33.3	4	X		X	X				X				
Long	Lake	0	0.0	0												
Main	Grundy	1	8.3	1												
McCollum	McHenry	0	0.0	0												
Minear	Lake	7	58.3	7	X	X	X	X	X	X		X				
Nelson Marsh	Kane	0	0.0	0												
Potomac	Lake	12	100.0	12	X	X	X	X	X	X	X	X	X	X	X	X
Redhead	Lake	0	0.0	0												
Silver	McHenry	8	66.7	8	X	X	X	X	X	X	X	X				
Slocum	Lake	8	66.7	10	X	X		X		X			X	X	X	X
Spring	Lake	1	8.3	1	X											
Sutton Place	Lake	1	8.3	1		X										
Thunderbird	McHenry	0	0.0	0												
Tower	Lake	1	8.3	3		X										
Valley	Cook	4	33.3	4		X		X		X	X					
West Loon	Lake	0	0.0	0												
Wonder	McHenry	9	83.3	10		X	X	X		X	X	X	X	X	X	
Northwest																
Apple R. Canyon	Jo Daviess	2	16.7	2	X			X								
Bass	Lee	10	83.3	10	X	X		X	X	X	X	X	X		X	X
Black Oak	Lee	1	8.3	1		X										
Fyre	Mercer	1	8.3	1	X											
Galena	Jo Daviess	1	8.3	1		X										
George	Rock Island	12	100.0	15	X	X	X	X	X	X	X	X	X	X	X	X
Spring	Winnebago	6	50.0	7		X	X		X	X	X	X				
Summerset	Stephenson/Winnebago	9	75.0	11	X	X		X	X	X	X	X	X		X	X
Sunset	Lee	10	83.3	10	X	X		X	X	X	X	X	X		X	X

TABLE 6. INDIVIDUAL LAKE DATA RETURNS, VOLUNTEER LAKE MONITORING PROGRAM, 1981 (continued).

Lake Name	County	No. of Time Periods Sampled	% of Time Periods Sampled	Total No. of Samples	Time Periods Sampled May 1	May 2	June 3	June 4	July 5	July 6	Aug. 7	Aug. 8	Sept. 9	Sept. 10	Oct. 11	Oct. 12
Northwest (Continued)																
Thunderbird	Putnam	1	8.3	1			X									
Wildwood	Marshall	0	0.0	0												
Woodhaven	Lee	9	75.0	9	X	X		X	X		X	X	X		X	X
East Central																
*Bloomington	McLean	4	33.3	4	X	X	X	X								
*Decatur	Macon	10	83.3	47			X	X	X	X	X	X	X	X	X	X
Evergreen	McLean	1	8.3	1	X											
*Iroquois	Iroquois	10	83.3	11	X	X	X	X	X	X	X	X	X	X		
Lake of the Woods	Champaign	12	100.0	15	X	X	X	X	X	X	X	X	X	X	X	X
*Mattoon	Coles	5	41.7	5			X	X	X				X		X	
*Oakland	Coles	12	100.0	12	X	X	X	X	X	X	X	X	X	X	X	X
*Paradise	Coles	5	41.7	5	X				X		X	X			X	
*Paris East Twin	Edgar	9	75.0	9	X	X	X	X		X	X		X	X		X
*Paris West Twin	Edgar	9	75.0	9	X	X	X	X		X	X		X	X		X
West Central																
Camelot	Peoria	0	0.0	0												
*Canton	Fulton	10	83.3	11	X	X	X			X	X	X	X	X	X	X
Clear	Calhoun	0	0.0	0												
*Glen Shoals	Montgomery	11	91.7	11	X	X	X	X	X	X		X	X	X	X	X
*Gillespie Old	Macoupin	5	41.7	5	X	X			X		X	X				
*Greenfield	Greene	7	58.3	7			X		X	X	X	X			X	X
Jacksonville	Morgan	1	8.3	1	X											
*LaHarpe	Hancock	9	75.0	10	X	X	X	X	X	X		X	X	X		
Lou Yaeger	Montgomery	12	100.0	12	X	X	X	X	X	X	X	X	X	X	X	X
Mauvaisse Terre	Morgan	0	0.0	0												
Northern Oaks	Tazewell	5	41.7	6	X	X	X			X	X					
Petersburg	Menard	12	100.0	12	X	X	X	X	X	X	X	X	X	X	X	X
Pohlman	Calhoun	7	58.3	7		X	X	X			X	X	X	X		
Rocky Ford	Montgomery	0	0.0	0												
Royal	Calhoun	7	58.3	7		X	X	X			X	X	X	X		
*Spring	McDonough	11	91.7	11	X	X	X	X	X	X	X	X	X	X	X	
*Springfield	Sangamon	11	91.7	11	X	X	X	X	X	X	X	X	X		X	X
Staunton Sportsmen's	Macoupin	5	41.7	5	X	X	X	X						X		
Swan	Calhoun	6	50.0	6		X		X			X	X	X	X		
*Taylorville	Christian	12	100.0	12	X	X	X	X	X	X	X	X	X	X	X	X
*Waverly	Morgan	12	100.0	12	X	X	X	X	X	X	X	X	X	X	X	X
Southern																
*Altamont New	Effingham	8	66.7	9		X	X	X	X	X	X	X			X	
*Ashley	Washington	12	100.0	12	X	X	X	X	X	X	X	X	X	X	X	X
Baldwin	St. Clair	9	75.0	9	X	X		X	X	X	X	X	X	X		
Benton	Franklin	7	58.3	7	X	X		X	X	X		X				X
Bi-County YMCA	St. Clair	0	0.0	0												
Borah	Richland	8	66.7	8	X		X	X	X	X		X		X	X	
Campus	Jackson	12	100.0	12	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 6. INDIVIDUAL LAKE DATA RETURNS, VOLUNTEER LAKE MONITORING PROGRAM, 1981 (continued).

Lake Name	County	No. of Time Periods Sampled	% of Time Periods Sampled	Total No. of Samples	Time Periods Sampled May 1	2	June 3	4	July 5	6	Aug. 7	8	Sept. 9	10	Oct. 11	12
Southern (Continued)																
Carlyle	Clinton	12	100.0	12	X	X	X	X	X	X	X	X	X	X	X	X
Crab Orchard	Williamson	0	0.0	0												
*Highland Silver	Madison	10	83.3	12	X	X	X	X	X		X	X	X		X	X
Kinkaid	Jackson	12	100.0	23	X	X	X	X	X	X	X	X	X	X	X	X
*Lake of Egypt	Johnson/Williamson	4	33.3	4		X					X	X	X			
Little Grassy	Williamson	9	75.0	10	X	X	X	X		X			X	X	X	X
Olney E. Fork	Richland	2	16.7	2		X				X						
*Omaha	Gallatin	9	75.0	12	X	X		X		X		X	X	X	X	X
*Pinckneyville	Perry	12	100.0	13	X	X	X	X	X	X	X	X	X	X	X	X
*Raccoon	Marion	6	66.7	8		X	X		X		X			X		X
*Salem	Marion	12	100.0	13	X	X	X	X	X	X	X	X	X	X	X	X
Sara	Effingham	8	66.7	9	X	X	X	X	X	X	X	X				
Spring Arbor	Jackson	6	50.0	7	X		X		X	X			X		X	
Stanberry	Fayette	1	8.3	1	X											
Thompson Fishing	Jackson	11	91.7	11	X	X	X	X	X	X	X	X	X	X	X	
Tower	Madison	4	33.3	4	X				X	X		X				
Vernor	Richland	8	66.7	8	X		X	X	X	X		X		X	X	
Vienna	Johnson	6	50.0	6	X		X	X	X	X	X					

*Lakes monitored by Public Water Supply Operators.